IBA TECHNICAL REVIEW

13

Standards for Television and Local Radio Stations

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IBA INDEPENDENT BROADCASTING AUTHORITY

IBA TECHNICAL REVIEW September 1980

ISSN 0308-423X

13 Standards for Television and Local Radio Stations

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IBA INDEPENDENT BROADCASTING AUTHORITY

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Introduction

by T S Robson, OBE
Director of Engineering
Independent Broadcasting Authority

Under the Independent Broadcasting Authority Acts, the Authority is specifically charged with providing television and local sound broadcasting services of high quality, both as to the transmission and as to the matter transmitted, for so much of the United Kingdom, the Isle of Man and the Channel Islands, as may from time to time be reasonably practicable.

While the IBA owns and operates its own transmitters, the programmes are produced by programme contractors who build and operate their own studios and studio equipment, field-production and outside-broadcast facilities.

When, in 1967, authorisation was given to go ahead with 625-line PAL colour on UHF for a November 1969 start, it was realised that ITV's regional system in colour, with its frequent re-configuration of the inter-city network and its regionally inserted programmes and advertisements, presented an exacting challenge. To meet this challenge and achieve consistent high quality, day-in, day-out, an IBA Quality Control Section was established with a dual purpose: (1) to establish and apply Codes of Practice for technical performance determined in consultation with the programme companies: and (2) to establish in conjunction with other IBA departments an effective method of monitoring and detecting those areas where further progress appears to be needed. The Codes are not intended as equipment specifications, nor does the Authority 'type approve' equipment; rather, the Codes are provided to establish good performance and standards in an operational environment over the system as a whole, taking into account the various signal paths. Technical quality is for the broadcaster an expensive commodity, and care is taken to ensure that the Codes are related to quality defects that can be observed on good-quality domestic receivers.

The enormous success of ITV colour encouraged the Authority to adopt a similar system when, in 1972, they became responsible for Independent Local Radio. From the outset of ILR all programme companies built and equipped their studios to an IBA Code of Practice: the high utilisation of disc and tape machines, in services often operating 24-hours a day, has shown that it was sensible in economic as well as engineering terms to encourage companies to invest in high-quality equipment.

An important feature of the IBA Codes is that they are frequently revised, in agreement with the programme companies, to take account of technological progress and developments.

This issue of the *IBA Technical Review* is devoted to the latest (1980) Codes: for television these are of special significance since they are the Codes for the new contracts that come into force in January 1982. They include for the first time a detailed description of improved test techniques for checking signal sources.

The IBA Codes of Practice have, of course, a special importance to industry; indeed, it is gratifying that they have formed the basis of standards used by broadcasters not only in the UK but in many parts of the world.

George Orwell once said, 'Orthodoxy is unconsciousness: not thinking, not needing to think'. It is not the purpose of our Codes of Practice to set broadcast technology into a rigidly orthodox mould. Deliberately we have adopted a flexible approach—but an approach which is designed to maintain and further improve the high technical standards of broadcasting in the UK.

Tom Robson.

The information contained in this volume supersedes certain chapters in *IBA Technical Review 2*—Technical Reference Book. The remaining chapters of *IBA Technical Review 2* are still relevant.

Standards for Television Studio Centre Performance

This Section is based on the Code of Practice for Television Studio Centre performance. This latest Code of Practice was drawn up by a joint IBA/ITCA Working Party consisting of:

P J Darby, IBA—Chairman
P J Marshall, IBA—Secretary
Shaun Clamp, Scottish Television—Chairman of ITCA Members
S G Blumson, London Weekend Television
F Brady, Ulster Television
C P Daubney, IBA
H J C Gower, Border Television
P A King, IBA
B J Lavelle, Tyne Tees Television
P J Marchant, ITN
A Merrett, Associated Television Network
J C Nichol, Tyne Tees Television
P Pearce, formerly Yorkshire Television
A J Rickards, Thames Television
J Q Rogers, Yorkshire Television
T Ross, Scottish Television.

The objective performance standards contained in the Code are applicable whether or not the circuits incorporate any form of digital encoding/decoding, transmission, processing or storage. Measurements are made on the analogue outputs of circuits under test. Videotape recorder performance standards cover 1-in as well as 2-in recorders.

In addition to the established 'worst path' requirements, studio path requirements are introduced. Measurements along this path can more easily be undertaken without interrupting the station output.

In addition to the studio path, two further paths have been included to cover outside broadcast paths, the OB scanner or mobile control room path and the OB link path. Experience has shown that both these paths can now be expected to provide performances similar to that of studio paths.

Finally, a substantial amount of investigatory work has resulted in the introduction of improved test techniques, particularly in the case of signal sources, and these are now included as part of each Section. In order to facilitate certain tests a number of test cards and films have been commissioned. Details and the availability of these, where applicable, have been indicated in the reference section. While it is felt that the methods described are the most appropriate, it is recognised that, in many instances, equally valid alternative methods exist.

Section 1 – Video Circuits and Equipment within the Signal Path

PART 1—PERFORMANCE REQUIREMENTS

1.1.1 Definitions and Operational Practices

DIRECT PATH

In measuring, the direct path is assumed to comprise the circuit from the agreed interface with the Post Office equipment, through the Presentation and Master Control switching and processing equipment, back to the agreed interface with the Post Office equipment.

WORST PATH

In measuring, the worst path is assumed to comprise the following, including all interconnections to the normal equipment routes:

i The source studio mixer
ii A looped VTR path
iii A second studio mixer
iv A second looped VTR path
v The Presentation and Master Control Path.

The tolerance limits do not include degradations due to signal sources such as cameras, telecines, or video tape recorders, because tolerances for these are separately specified. Normally, measurement of the Worst Path Parameters is necessary only after the completion of a new installation or a major reinstallation.

STUDIO PATH

In measuring, the Studio Path will comprise that part of the system which starts at the output of any source and is routed through the normal assignment paths, one studio, the normal studio output assignment path and ends at the interface with VTR or MCR.

OB SCANNER PATH

OB scanner vision tolerances relate to circuits from the colour encoder output to the agreed interface with the OB link including all mixing, switching and processing equipment normally in use in programme operation.

General purpose OB and EFP Cameras are covered by Section 5 of this review. Mobile VTRs are covered by Section 3 of this review.

OB LINK PATH

OB link tolerances are related to an unspecified number of point-to-point SHF links. Measurement is made at the final output of the link at which point connection to a permanent circuit would be made.

	DIRECT PATH	WORST PATH	STUDIO PATH	OB SCANNER PATH	OB LINK PATH
1.1.2 Signal Levels*					
a Signal Level	0·7 V	0·7 V	0·7 V	0·7 V	0·7 V
Adjustment error	±0·2 dB	±0·2 dB	±0·2 dB	±0·2 dB	±0·2 dB
b Signal Level Gain Stability	±0·2 dB	±0·5 dB	±0·2 dB	±0·2 dB	±0·2 dB

* Post Office Technical Guides Nos. 25 and 26 refer.

	DIRECT PATH	WORST PATH	STUDIO PATH	OB SCANNER PATH	OB LINK PATH
1.1.3 Linear Waveform Distortion					
a 2T Pulse-to-Bar K Rating	½% K	1% K	½% K	½% K	2% K
b 2T Pulse Response	½% K	1% K	½% K	½% K	2% K
c 2T Bar Response	½% K	1% K	½% K	½% K	2% K
d 50 Hz Square Wave Response	½% K	1% K	½% K	½% K	2% K
e Chrominance/Luminance Gain Inequality	± 3%	± 4%	± 3%	± 3%	± 4%
f Chrominance/Luminance Delay Inequality	± 20 ns	± 40 ns	± 20 ns	± 20 ns	± 20 ns
1.1.4 Non-Linearity Distortion					
a Luminance Line-Time Non-Linearity	3%	5%	3%	3%	5%
b Differential Phase	± 2°	± 5°	± 2°	± 2°	± 5°
c Burst/Chroma Phase	± 2°	± 5°	± 2°	± 2°	—
d Differential Gain	± 3%	± 5%	± 3%	± 3%	± 5%
e Transient Gain Change, Luminance	2%	5%	2%	2%	5%
f Transient Gain Change, Chrominance	2%	5%	2%	2%	5%
g Transient Gain Change, Sync	2%	5%	2%	2%	5%
h Chrominance/Luminance Crosstalk	—	—	—	—	± 3%
1.1.5 Input/Output Impedance – Return Loss					
a Luminance	−30 dB	−30 dB	−30 dB	−30 dB	−30 dB
b Chrominance	−30 dB	−30 dB	−30 dB	−30 dB	−30 dB
c Low Frequency	−30 dB	−30 dB	−30 dB	−30 dB	−30 dB
1.1.6 VLF Response					
a First Overshoot	20%	20%	—	20%	20%
b Second Overshoot	8%	8%	—	8%	8%
1.1.7 Noise					
a Weighted Luminance (RMS)	−64 dB	−58 dB	−64 dB	−64 dB	−55 dB
b Weighted Chrominance (RMS)	−58 dB	−52 dB	−58 dB	−55 dB	−52 dB
c Total Low Frequency Random and Periodic (p–p)	−45 dB	−45 dB	−45 dB	−45 dB	−40 dB
d Low Frequency Random (p–p)	−52 dB	−52 dB	−52 dB	−52 dB	−45 dB
e Interchannel Crosstalk	−55 dB	−45 dB	−52 dB	−55 dB	—
1.1.8 Modulation Derived Distortion (Sound to Vision Crosstalk)					
a Sound Subcarrier Modulated	—	—	—	—	−52 dB
b Sound Subcarrier Unmodulated (Level of Intermodulation products between sound and chrominance subcarriers)	—	—	—	—	−57 dB

PART 2—TEST METHODS

1.2.1 Test Conditions

Before commencing any measurement, all test equipment should be checked for accuracy. Any inaccuracy should be corrected, if possible, or noted and allowed for in the measurement.

This Section gives examples of test methods that use basic techniques. These examples do not preclude the use of other valid methods. The use of ITS type test signals is not precluded but the CCIR waveforms referred to in these notes are regarded as the primary standard.

The signals specified below are applied to the path under test; when vision mixers are included in the path then the route should include the shortest normally used path through each vision mixer and any processing amplifiers that are normally used. The processing amplifiers should be set to the mode in which they are normally used operationally.

1.2.2 Signal Levels

a SIGNAL LEVEL ADJUSTMENT ERROR

The test may be made by use of a calibrated television waveform monitor. The insertion gain may be measured by using a 75 ohm generator of the 2T pulse-and-bar test signal as shown in Section 9, Ref. 1. The generator should be adjusted such that the bar amplitude is 700 mV and the synchronising pulse amplitude is 300 mV. The sine-squared pulse is ignored in this application. At the output, the bar amplitude should be measured and the ratio, expressed in dB, of the amplitude of 700 mV is taken as the insertion gain.

b SIGNAL LEVEL GAIN STABILITY

Having completed the measurements in 1.2.2*a*, no level adjustment to the equipment should be made for a period of one hour. The measurements of 1.2.2*a* should be repeated using the identical path, and any change recorded as the parameter for this sub-section.

1.2.3 Linear Waveform Distortion

a 2T PULSE-TO-BAR RATIO

The test signal should be the 2T pulse-and-bar waveform as specified in Section 9, Ref. 1.

The pulse-to-bar ratio (K-rating) is defined as:

$$K = \frac{B - P}{4P} \times 100\%$$

where B and P are the amplitudes of the bar and pulse respectively.

Therefore, in practice, to make the measurement, the pulse will be taken as reference.

Set the pulse amplitude to be 100% on the centre scale of an appropriate graticule (Section 9, Ref. 4) and divide by four the percentage difference in amplitude between the pulse and the bar measured at its mid-point, to obtain the K-rating.

When the waveform is subject to line tilt or an extended distortion along the leading edge at the top of the bar, the amplitude of the bar must be measured at its mid-point after first setting the blanking level mid-way between two successive bars to 0%.

b 2T PULSE RESPONSE

The test signal should be the 2T pulse-and-bar waveform as specified in Section 9, Ref. 1. Measurement may be made by use of a graticule such as that shown in Section 9, Ref. 4.

The vertical gain is adjusted to make the pulse amplitude 100% and then the vertical shift moved to bring the blanking level onto the base line at 30%. The horizontal gain is advanced and the horizontal shift adjusted to make the waveform touch the HAD markers on the 80% line. With normal gain the graticule markers are 2% K and 4% K. For 1% K and 2% K the calibrated vertical gain is advanced by × 2. For limits of $\frac{1}{2}$% K and 1% K the pulse amplitude is first set to 80% and the calibrated vertical gain then advanced by × 5.

If it is desired to measure the K rating exactly, the variable vertical gain should be adjusted until the worst pulse overshoot just touches the inner limits. The calibrated gain is then returned to normal and the amplitude of the pulse measured (P%), then:

$$K = \frac{200}{P \times \text{Calibrated gain}} \%$$

PULSE AMPLITUDE	× 5 GAIN
100	0·4%K
80	0·5%K
67	0·6%K
57·5	0·7%K
50	0·8%K

c 2T BAR RESPONSE

The test signal should be the 2T pulse-and-bar waveform as specified in Section 9, Ref. 1.

The horizontal timebase of the oscilloscope is adjusted so that the half amplitude points of the bar reach the outer limits marked on a graticule such as that shown in Section 9, Ref. 4.

Ignoring the first and last 2·5% (0·625 μs) of the bar, the deviation from its mid-point, expressed as a percentage of its amplitude at that point, is the K rating of the bar. It must be emphasised that measurements are made by using only half the bar, the worse half being quoted as the result. Measuring the whole bar and then dividing by two to obtain the K rating is an incorrect procedure.

d 50 Hz SQUARE WAVE RESPONSE

The test signal should be the 50 Hz square wave test signal as specified in Section 9, Ref. 5.

With the horizontal scan set at field rate the 50 Hz signal is adjusted as in 1.2.3*c*. For a stationary display the signal must contain field synchronising pulses. Again, ignoring the first and last 2·5% (250 μs), the percentage deviation of the worse half divided by 2 is the K rating of the bar. (It may be noted that, for the

same deviation on the display, a 4% K figure for the bar response looks the same as that of 2% K for 50 Hz).

e CHROMINANCE/LUMINANCE GAIN INEQUALITY

The measurement is best made by using the 2Tc non-composite waveform (Section 9, Ref.6b). The 50% luminance pedestal is used to calibrate vertical gain of the oscilloscope. The chrominance amplitude is then measured directly.

NB. The use of the composite 2Tc waveform with a gain and delay test set will produce an erroneous result in the presence of chrominance/luminance crosstalk.

f CHROMINANCE/LUMINANCE DELAY INEQUALITY

The measurement is made by using a 2Tc composite pulse-and-bar signal (Section 9, Ref.6a) and a delay measuring test set.

The output of the test set is viewed on an oscilloscope and the test set adjusted to cancel any path chrominance/luminance delay inequality.

1.2.4 Non-Linearity Distortion

a LUMINANCE LINE-TIME NON-LINEARITY

The test signal consists of a 5-step staircase (Section 9, Ref.2) occupying one line in every four, followed by three lines of either black or white. Measurements are made with three lines of white (bar on) and with three lines of black (bar off) and the worse result quoted.

It should be noted that the staircase with added subcarrier waveform is used to conform with CCIR recommended practice.

At the receiving end the test signal is passed through a suitable differentiating network (Section 9, Ref.3) and amplifier and displayed on an oscilloscope. The result is a train of five pulses. Non-linearity is measured as the difference in amplitude between the largest and the smallest, expressed as a percentage of the largest.

$$\text{i.e., } \frac{E_{max} - E_{min}}{E_{max}} \times 100\%$$

b DIFFERENTIAL PHASE

The test signal should be a 5-step staircase with added subcarrier (Section 9, Ref.2).

The differential phase may be measured by using a vectorscope in the line-time mode. The six sections of subcarrier are compared for their phase relationships taking the blanking level section as a reference. The differential phase is defined as the largest departure in phase from that reference. Measurements are made with the white bar on and with the white bar off and the worse measurement is quoted.

c BURST/CHROMA PHASE

Burst/Chroma Phase errors may be measured as follows. Display colour bars on a vectorscope and, after aligning the burst on the graticule, carefully measure the phase displacement (if any) of the BLUE bar. Apply the colour bar signal to the equipment or path under test and display the output signal on the vectorscope. After aligning the burst on its graticule, measure again the BLUE bar phase displacement. Phase measurement minus the phase displacement of the original signal indicates the burst/chroma distortion due to the equipment or path under test.

d DIFFERENTIAL GAIN

The test signal should be a 5-step staircase with added subcarrier (Section 9, Ref.2).

The differential gain may be measured by using a vectorscope in the line-time mode. The six sections of subcarrier are compared for their amplitude relationship and, taking the blanking level section as a reference, the differential gain is defined as the largest departure in amplitude from that reference. Measurements are made with the white bar on and with the white bar off and the worse measurement is quoted.

NOTE ON TRANSIENT DISTORTION APPLICABLE TO SUB-SECTIONS (e), (f) & (g) BELOW

The transient gain change due to a change of Average Picture Level (APL) is defined as the maximum transient departure in the amplitude of each component from that which existed before the change in APL, expressed as a percentage of the original amplitude. Separate measurements are made on the 5-step staircase with added subcarrier (Section 9, Ref.2), with the APL changed from low (intervening lines at blanking level) to high (intervening lines at white level) and from high to low.

e TRANSIENT GAIN CHANGE, LUMINANCE *(See note above)*.

At the receiving end the test signal is passed through a suitable differentiating network (Section 9, Ref.3), amplified and displayed on an oscilloscope (some commercial filters with amplifiers overload at normal signal level and require about 10 dB reduction of input signal level).

The oscilloscope should be synchronised by an external source, and the black level clamp or DC restorer should be switched off. Movement of the base line of the waveform when the APL is changed

indicates overload or some other non-standard measuring condition.

With the generated waveform producing intervening black lines, set the oscilloscope to make each spike (corresponding to a step) equal 100%. Measure the maximum transient departure from 100% of each of the spike amplitudes when the APL is switched from low to high and vice versa.

The largest departure from 100% is taken as the result and it should be noted whether the change is predominantly on only one spike and, if so, on which spike.

f TRANSIENT GAIN CHANGE, CHROMINANCE *(See note above)*.
Set up the oscilloscope, using the chrominance filter, and measure the maximum transient departure from 100% of the peak-to-peak subcarrier amplitude on the third step, when the APL is switched from low to high and vice versa.

g TRANSIENT GAIN CHANGE, SYNC *(See note above)*.
Using the differentiating network, amplifier and oscilloscope as in (e) above, set the oscilloscope so that the amplitude of the positive spike corresponding to the trailing edge of sync equals 100% with intervening lines at black.

Measure the maximum transient departure from 100% of the spike amplitude when the APL is switched from low to high and vice versa.

h CHROMINANCE/LUMINANCE CROSSTALK
The 2Tc pulse-and-bar waveform (Section 9, Ref.6b) should be used for the test. The crosstalk, which manifests itself as a change in the mean level of the pedestal during transmission of the chrominance component, should be expressed as a percentage of the picture level, as determined by the measurement described in para. 1.2.2*a* (nominally 700 mV).

1.2.5 Input/Output Impedance – Return Loss

a, b, c RETURN LOSS
The measuring point for this test should be the point to which the external circuits are equalised by the Post Office.

The test is applied by using a 2T pulse-and-bar waveform in conjunction with a return loss bridge which should first be calibrated using two very closely matched, 75 ± 0·1% ohm resistors.

In addition, the same leads should be used for calibration and measurement and the reference path lead should be identical with the main path connection. With one return loss bridge presently available, a calibration distortion of −40 dB is provided; if this bridge is used the output is displayed on an oscilloscope and adjusted to give a reference display (5 divisions, for example). The bridge is then rearranged to include the circuit under test and the degree of output imbalance is measured. The return loss is then calculated by linear interpolation. For large mismatches a 10 dB switch is incorporated in the bridge to allow calibration at −30 dB. When measuring output impedance the input signal should be removed and the input terminated. For very small return loss measurements an external trigger to the oscilloscope is often necessary.

The test should be repeated using the 2T pulse-and-bar and the 50 kHz waveforms. These results are respectively recorded as the (a) Luminance, (b) Chrominance and (c) Low Frequency, parameters.

1.2.6 VLF Response

The signal used should switch all lines to black or white. The switching should occur at a rate sufficiently slow to allow the waveform to settle before the following transition. The 1st and 2nd overshoots of blanking level variation are measured (Fig. 1.1) and expressed as a percentage of standard picture level (700 mV peak-to-peak).

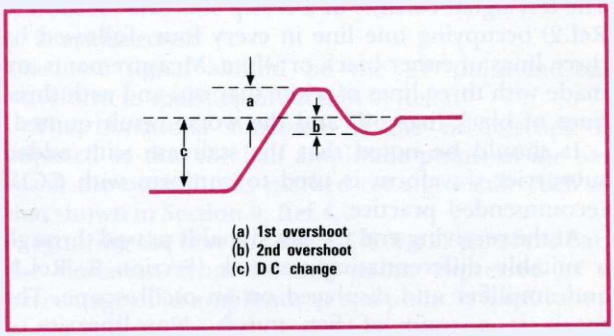


Figure 1.1

It should be noted that the DC change ('c' in Fig. 1.1) is not measured since it is a function only of the test signal.

Both the black-to-white and the white-to-black transitions are measured and the worse result quoted.

A DC coupled oscilloscope with a very slow timebase may be used for these measurements. Alternatively, if only a television waveform monitor is available, a line rate display should be used with the Y amplifier switched to DC coupled and the DC restorer switched off.

1.2.7 Noise

Measurement is made by use of a 10% lift signal. Care should be taken to ensure that the noise of the generated signal is not significant.

a WEIGHTED LUMINANCE

Measurement is made within the band 7·5 kHz–5·0 MHz using RMS detection. The characteristic of the luminance weighting filter is shown in Section 9, Ref.7.

b WEIGHTED CHROMINANCE

Measurement is made within the band 3·5 MHz–5·5 MHz as defined only by the characteristic of the weighting filter, as shown in Section 9, Ref.7, and using RMS detection.

c TOTAL LF, RANDOM AND PERIODIC

The total LF noise should be measured peak-to-peak within the band 40 Hz–7·5 kHz.

d LF RANDOM

Measurement is made peak-to-peak within the band 40 Hz–7·5 kHz, as above, but using a comb filter to attenuate periodic components. Care should be taken to compensate for any effect of field gating on the measurement. If the signal being fed to the detector is examined on an oscilloscope at field rate it will be seen that the waveform contains spikes due to field blanking. The reading should be corrected to allow for this. For instance, if the oscilloscope gain is adjusted to make the blanking spikes 10 cm on the display and the general noise peaks are 5 cm, then the measured reading should be reduced by 6 dB.

e INTERCHANNEL CROSSTALK

One channel, selected for the measuring of received crosstalk interference, is fed with a blanking and sync waveform.

Another channel, considered as being the nearest electrically adjacent, is used as the hostile channel. This is fed with Colour Bars (Section 9, Ref.8).

The signal-to-crosstalk ratio is defined as the ratio, expressed in dB, of the normal peak-to-peak amplitude of the picture signal to the peak-to-peak amplitude of the crosstalk waveform.

1.2.8 Modulation Derived Distortion (Sound-to-Vision Crosstalk)

a SOUND SUBCARRIER MODULATED

Measured with whole-time 5-step staircase, without chrominance subcarrier, into the vision channel and + 8 dBu at 1 kHz into the sound channel. The crosstalk should be measured unweighted, peak-to-peak, in the frequency band 40 Hz to 7·5 kHz, using a noise measuring set. The result is expressed with reference to standard picture level (700 mV p-p).

b SOUND SUBCARRIER UNMODULATED

Measured with whole-time 5-step staircase, with chrominance subcarrier, into the vision channel and no sound modulation. The crosstalk should be measured luminance weighted, peak-to-peak, in the frequency band 40 Hz to 5·0 MHz, using a noise measuring set. The result is expressed with reference to standard picture level (700 mV p-p).

Section 2 – Audio Circuits and Equipment within the Signal Path

PART 1 – PERFORMANCE REQUIREMENTS

2.1.1 Definitions and Operational Practices

DIRECT PATH

For purposes of measuring, the Direct Path is assumed to comprise the circuit from the agreed interface with the Post Office equipment, through the Presentation and Master Control switching and processing equipment, back to the agreed interface with the Post Office equipment.

WORST PATH

For purposes of measuring, the worst path is assumed to comprise the following, with all interconnections made, and using the normal equipment routes:

- i A studio mixer
- ii A looped VTR path
- iii A second studio mixer
- iv A second looped VTR path
- v The Presentation and Master Control Path.

The input signal may be either an assigned source or commence at a studio wall box microphone input.

The tolerance limits do not include degradations due to signal sources such as tape recorders, because tolerances for these are separately specified.

A measurement of the Worst Path parameters is normally necessary only after completion of a new installation or a major re-installation.

STUDIO PATH

For purposes of measuring, the Studio Path will comprise that part of the system which starts at the output of any source and is routed through the normal assignment paths, one studio, the normal studio output assignment path and ends at the interface with VTR or MCR.

The Path may comprise that described above, or commence at a studio wall box microphone input and then comprise the studio mixer and the output paths, as above.

OB SCANNER PATH

The tolerances relate to circuits originating from microphone or line level inputs, including normal connections to the tail-board, and which follow a typical path through the audio mixer and any subsequent line-sending amplifier. Measurements are made at the agreed interface with the OB link.

OB LINK PATH

OB link tolerances are related to an unspecified number of point-to-point SHF links. Measurement is made at the final output of the link, at which point connection to a permanent circuit would be made.

	DIRECT PATH	WORST PATH	STUDIO PATH	OB SCANNER PATH	OB LINK PATH
2.1.2 Output Signal Level*					
a Output signal level at agreed interface after line-up.	0 dBm ±0·25 dB	0 dBm ±0·5 dB	0 dBu ±0·25 dB	0 dBm ±0·25 dB	0 dBm ±0·25 dB
b Gain Stability, variation of insertion gain during one hour.	±0·25 dB	±0·5 dB	±0·25 dB	±0·25 dB	±0·25 dB
* Post Office Technical Guides No's 25 and 26 refer. 0 dBu and 0 dBm correspond to 40% of the maximum permitted signal level.					
2.1.3 Amplitude/Frequency Response					
a 40 Hz–15 kHz wrt 1 kHz	$^{+1}_{-2}$ dB	$^{+1}_{-3}$ dB	$^{+1}_{-2}$ dB	$^{+1}_{-2}$ dB	$^{+0\cdot5}_{-3\cdot0}$ dB
b 125 Hz–10 kHz wrt 1 kHz	$^{+1}_{-1}$ dB	$^{+1}_{-2}$ dB	$^{+1}_{-1}$ dB	$^{+1}_{-1}$ dB	$^{+0\cdot5}_{-2\cdot0}$ dB
2.1.4 Total Harmonic Distortion					
a 1 kHz at −10 dBu	0·5%	0·5%	0·5%	0·5%	1·0%
b 1 kHz at +8 dBu	0·5%	1·0%	0·5%	0·5%	1·0%
c 80 Hz at −10 dBu	0·5%	0·5%	0·5%	0·5%	1·0%
d 80 Hz at +8 dBu	0·5%	2·0%	1·0%	1·0%	1·0%
e Input Overload	—	—	17 dB	17 dB	—
2.1.5 Signal/Noise Ratio					
a 0 dBu input					
i Weighted, Random, Peak	60 dB	56 dB	60 dB	60 dB	42 dB
ii Unweighted, Random, Peak	—	—	63 dB	63 dB	47 dB
b −50 dBu input					
i Weighted, Random, Peak	—	53 dB	56 dB	56 dB	—
ii Unweighted, Random, Peak	—	—	60 dB	60 dB	—
c Interchannel Crosstalk, Weighted, Peak	53 dB	53 dB	53 dB	53 dB	—
2.1.6 Modulation Derived Distortion					
a Vision-to-Sound Crosstalk, Weighted	—	—	—	—	45 dB

NOTE: *This definition of signal level applies only to equipment test measurements. In the case of lines measurement, where complex impedances are frequently encountered, it is normal practice when setting levels to send from a specified source impedance and to substitute a fixed resistance (usually 600 ohms) at the point of measurement.*

PART 2 – TEST METHODS

2.2.1 Test Conditions

Normally, signal levels are measured as voltages irrespective of impedance and are quoted in dB with reference to 0 dBu, where 0 dBu corresponds to 0·775 V, RMS. This definition of signal level applies throughout these standards for equipment measurements but does not apply to line measurement.

2.2.2 Output Signal Level

The measurements may be made at any overall gain setting. The PPMs, which are used to control the programme output levels of each mixer, will be used as the indicating meters.

With the input level set constant at −50 dBu for microphone level inputs, or 0 dBu for line level inputs, the greatest change of output occurring in one hour is defined as the gain stability.

2.2.3 Amplitude/Frequency Response

This measurement may be made at any gain setting up to the maximum available; the output level should be approximately 0 dBu on each output when the measurement is made.

Tests should be made at the following frequencies and the measurements should be referenced to the level at 1 kHz:

40 Hz, 60 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 6 kHz, 8 kHz, 10 kHz, 12 kHz, 15 kHz.

Additional tests should be made to ensure that the overall response falls smoothly outside this frequency band.

It should be noted that, as this test is a measurement of the variation of gain of the equipment with frequency, corrections should be made for any variation in the input level with frequency.

2.2.4 Total Harmonic Distortion

i For microphone channels, −50 dBu input with normal balance attenuator, channel, group and main fader settings to achieve 0 dBu output.

ii For line level channels, 0 dBu input with normal balance attenuator, channel, group and main fader settings to achieve 0 dBu output.

The input signal level is varied to give an output level of first −10 dBu and then +8 dBu wrt line-up. At each level, the tests are made at 80 Hz and 1 kHz.

For microphone inputs only, additional tests of input overload capability at 80 Hz and 1 kHz are made. The input signal level is slowly increased and the channel fader adjusted to keep the output level at +8 dBu (i.e., peak signal level) until the onset of gross distortion (for the purposes of this measurement this is defined as 3%). The increase in input signal level above normal peak input level, −42 dBu, is the input overload capability.

2.2.5 Signal/Noise Ratio

The noise levels are measured by using a test set incorporating a standard PPM (to BS4297), and a low-noise amplifier with calibrated variable gain. The 'unweighted' bandwidth is limited to the range 22·4 Hz–22·4 kHz by a bandpass filter, and the 'weighted' frequency response is determined by the CCIR network, as defined in Rec.468-1. The frequency response of this network is shown in Section 9, Ref.9.

1 kHz tone at the appropriate level is fed to the path under test and the gain of the test set is adjusted so that the PPM gives a scale reading of '4' (i.e., 0 dBu). The input signal is then replaced by a termination (as defined below) and the gain of the test set is readjusted so that the PPM again peaks to the scale reading of '4'. The signal/noise ratio is the difference between the two settings of the test set gain. The measurements are made both weighted and unweighted.

a LINE LEVEL PATH (0 dBu)
The input should be terminated in 600 ohms.

b MICROPHONE INPUT (−50 dBu)
Balance attenuator, channel, group and main faders should be set as for normal operation. The input should be terminated in 300 ohms directly at the injection point.

c CROSSTALK
The interfering signal, consisting of a 7 kHz tone, is fed to an adjacent input of each sound desk and switching matrix in the path under test. The interfering path is lined-up, using separate group and output faders where this is possible without mixing with the path under test. Desk inputs may be at microphone level (−50 dBu) or line level (0 dBu). When the interfering path has been lined-up the input level is raised by 8 dB. The input of the path under test is terminated and the peak weighted output level of the path under test is then measured on a noise meter. A bandpass filter may be needed to separate the crosstalking tone from random noise.

2.2.6 Modulation Derived Distortion (Vision-to-Sound Crosstalk)

Measured as noise (para. 2.2.5), with vision channel modulated by 100% amplitude, 100% saturated colour bars.

Section 3 – Video Tape Recorders

PART 1 – PERFORMANCE REQUIREMENTS

3.1.1 Definitions and Operational Practices

Tolerances listed for video tape recorders refer to a single recording and replay not necessarily on the same machine.

The operational practices and procedures relating to video tape recordings should be in conformity with Chapter 3 of the Broadcast Video Tape Recording Handbook of Sub-Group 11C of UK National Study Group 11 of the CCIR, where relevant.

The tolerances are based on full field measurements and the most common and straightforward methods of measurement are given in Part 2. Where alternative methods, giving more accurate results, are available these are mentioned in the appropriate paragraph.

The tolerances given below apply to both quadruplex and helical recorders. The requirements for helical recorders will be reconsidered when sufficient experience of their day-to-day performance has been acquired.

VIDEO TOLERANCES

3.1.1 (Omitted)	
3.1.2 Output Signal Level	
a Adjustment Error	±0·2 dB
b Gain Stability (thoughout 1 hour)	±0·2 dB
3.1.3 Linear Waveform Distortion	
a 2T Pulse-to-Bar K Rating	2% K
b 2T Pulse Response	2% K
c 2T Bar Response	2% K
d 50 Hz Square Wave Response	2% K
e Chrominance/Luminance Gain Inequality	±3%
f Chrominance/Luminance Delay Inequality	±20 ns
3.1.4 Non-Linearity Distortion	
a Luminance Line-Time Non-Linearity	6%
b Differential Phase	±6°
c Differential Gain	±6%
d Transient Gain Change, Luminance	2%
e Transient Gain Change, Chrominance	2%
f Transient Gain Change, Sync	2%
3.1.5 Noise	
a Weighted Luminance (RMS)	−52 dB
b Weighted Chrominance (RMS)	−46 dB
c Total Low Frequency Random and Periodic (p–p)	−46 dB
d Low Frequency (p–p)	−52 dB
e Moiré and Chrominance Modulation Noise	−25 dB

AUDIO TOLERANCES

3.1.6 Output Signal Level	
a Signal level at output after line-up	0 dBu ± 0·25 dB
b Gain Stability	± 0·5 dB
3.1.7 Amplitude/Frequency Response	
a 40 Hz–15 kHz wrt 1 kHz	± 2 dB
b 125 Hz–10 kHz wrt 1 kHz	± 1 dB
3.1.8 Total Harmonic Distortion	
a 1 kHz at + 8 dBu	3%
b 80 Hz at + 8 dBu	3%
3.1.9 Signal/Noise Ratio	
a Weighted, Random, Peak	38 dB
b Weighted Crosstalk to Audio Track(s)	imperceptible
3.1.10 Wow and Flutter	
Weighted, Peak	0·15%

PART 2 – TEST METHODS

VIDEO MEASUREMENTS

3.2.1, 3.2.2 (Omitted)

3.2.3 Linear Distortion

a 2T PULSE-TO-BAR K RATING

The signal should be the 2T pulse-and-bar waveform as shown in Section 9, Ref.1.

The K-rating of the pulse-to-bar ratio is defined as:

$$K = \frac{B-P}{4P} \times 100\%$$

where, B and P are the amplitudes of the bar and pulse respectively.

Set the pulse amplitude to be 100% on the centre scale of an appropriate graticule (Section 9, Ref.4) and divide by four the percentage difference in amplitude between the pulse and the bar measured at its mid-point, to obtain the K rating.

When the waveform is subject to line tilt or an extended distortion of the leading edge at the top of the bar, the amplitude of the bar must be measured at its mid-point, the blanking level mid-way between two successive bars having first been set to 0%.

b 2T PULSE RESPONSE

The test signal should be the 2T pulse-and-bar waveform as specified in Section 9, Ref.1. Measurement may be made by using a graticule such as that shown in Section 9, Ref.4.

If this graticule is used, the vertical gain of the oscilloscope is adjusted to make the pulse amplitude 100% and the vertical shift then moved to bring the blanking level onto the base line at 30%. The horizontal gain is advanced and the horizontal shift adjusted to make the waveform touch the HAD markers on the 80% line. With normal gain the graticule markers are 2% K and 4% K. For 1% K and 2% K the calibrated vertical gain is advanced by × 2. For limits of ½% K and 1% K the pulse amplitude is first set to 80% and the calibrated vertical gain then advanced by × 5.

c 2T BAR RESPONSE

The test signal should be the 2T pulse-and-bar waveform as shown in Section 9, Ref.1.

The horizontal timebase of the oscilloscope is adjusted so that the half amplitude points of the bar reach the outer limits marked on a graticule such as that shown in Section 9, Ref.4.

Ignoring the first and last 2·5% (0·625 μs) of the bar, the deviation from its mid-point, expressed as a percentage of its amplitude at that point, is the K rating of the bar. Measurements are made by using only half the bar, the worse half being quoted as the result. It is impermissible to measure the whole bar tilt and divide by two to obtain the K rating.

d 50 HZ SQUARE WAVE RESPONSE

The test signal should be the 50 Hz square wave test signal as shown in Section 9, Ref.5, but with added field synchronising pulses.

With the horizontal scan at field rate the 50 Hz signal is adjusted as in 3.2.3*c*. For a stationary display the signal must contain field synchronising pulses. Ignoring the first and last 2·5% (250 μs), the percentage deviation of the worse half divided by 2 is the K rating of the bar. (It may be noted that, for the same deviation on

the display, a 4% K figure for the bar response looks the same as 2% K for 50 Hz).

e, f CHROMINANCE/LUMINANCE GAIN AND DELAY INEQUALITY
The measurements are made by using a 2Tc composite pulse-and-bar signal (Section 9, Ref.6a) with the output of the path under test fed to a Gain and Delay test set. The output of the test set is viewed on an oscilloscope and the test set is adjusted to make the envelope of the chrominance pulse flat along the baseline.

It should be noted that if Chrominance/Luminance crosstalk is present, the above method for measuring gain inequality will produce an erroneous result. The measurement is best made by using the 2Tc non-composite waveform (Section 9, Ref.6b). The 50% luminance pedestal is used to calibrate the vertical gain of the oscilloscope, and the chrominance amplitude is measured directly.

3.2.4 Non-Linearity Distortion

a LUMINANCE LINE-TIME NON-LINEARITY
The test signal consists of a 5-step staircase (Section 9, Ref.2) occupying one line in every four, followed by three lines of either black or white. Measurements are made with three lines of white (bar on) and with three lines of black (bar off) and the worse result quoted.

The output signal is passed through a suitable differentiating network (Section 9, Ref.3), amplified (if necessary) and displayed on an oscilloscope. The result is a train of five pulses. Non-linearity is measured as the difference in amplitude between the largest and the smallest pulses expressed as a percentage of the largest:

$$\text{i.e., } \frac{E_{max} - E_{min}}{E_{max}} \times 100\%$$

b DIFFERENTIAL PHASE
The test signal should be a 5-step staircase with added subcarrier (Section 9, Ref.2).
The differential phase may be measured by using a vectorscope in the line-time mode. The six sections of subcarrier are compared for their phase relationships taking the blanking level section as a reference. The differential phase is defined as the largest departure in phase from that reference. Measurements are made with the white bar on and with the white bar off and the worst measurement is quoted.

c DIFFERENTIAL GAIN
The test signal should be a 5-step staircase with added subcarrier (Section 9, Ref.2).

The differential gain may be measured by using a vectorscope in the line-time mode. The six sections of subcarrier are compared for their amplitude relationships and, taking the blanking level section as a reference, the differential gain is defined as the largest departure in amplitude from that of the reference expressed as a percentage. Measurements are made with the white bar on and with the white bar off and the worst measurement is taken as the result.

The measurements in paragraphs 3.2.4(a) and (b) are difficult to make accurately on a VTR due to the presence of noise, moiré and jitter. More accurate measurements can be made by using a suitable non-linearity test set, preferably one which integrates the measurement and has a line strobe facility. Some improvement can also be obtained by using a 200 kHz low-pass filter in the display circuit of a vectorscope.

NOTE ON TRANSIENT DISTORTION APPLICABLE TO SUB-SECTIONS *d*, *e* & *f* BELOW

The transient gain change due to a change of Average Picture Level (APL) is defined as the maximum transient departure in the amplitude of each signal component from that which existed before the change in APL, expressed as a percentage of the original amplitude. Separate measurements are made on the 5-step staircase with added subcarrier (Section 9, Ref.2), with the APL changed from low (intervening lines at blanking level) to high (intervening lines at white level) and from high to low.

d TRANSIENT GAIN CHANGE, LUMINANCE (*SEE NOTE ABOVE*).
The reproduced test signal is passed through a suitable differentiating network (Section 9, Ref.3), amplified and displayed on an oscilloscope (some commercial filters with amplifiers overload at normal signal level and require about 10 dB reduction of input signal level).

The oscilloscope should be synchronised by an external source and the black level clamp or DC restorer should be switched off. Movement of the baseline of the waveform when the APL is changed indicates overload or some other non-standard measuring condition.

With the generated waveform producing intervening black lines, set the oscilloscope to make each spike (corresponding to a step) equal 100%. Measure the maximum transient departure from 100% of each of the spike amplitudes when the APL is switched from low to high and vice-versa. The largest departure from 100% is taken as the result and it should be noted whether the change is predominantly on only one spike and, if so, on which spike.

e TRANSIENT GAIN CHANGE, CHROMINANCE (*See note above*).
Set up the oscilloscope using the chrominance filter and measure the maximum transient departure from 100% of the peak-to-peak subcarrier amplitude on the third step, when the APL is switched from low to high and vice-versa.

f TRANSIENT GAIN CHANGE, SYNC (*See note above*).
Using the differentiating network, amplifier and oscilloscope as in (*d*) above, set the oscilloscope so that the amplitude of the positive spike corresponding to the trailing edge of sync equals 100% with intervening lines at black.

Measure the maximum transient departure from 100% of the spike amplitude when the APL is switched from low to high and vice-versa.

3.2.5 Noise

Noise measurements should be made by use of a 50% pedestal test signal.

a WEIGHTED LUMINANCE
Measurement is made within the band 7·5 kHz–5·0 MHz using RMS detection. The characteristic of the luminance weighting filter is shown in Section 9, Ref.7.

b WEIGHTED CHROMINANCE
Measurement is made within the band 3·5 MHz–5·5 MHz as defined only by the characteristic of the weighting filter, as shown in Section 9, Ref.7, and using RMS detection.

c TOTAL LF RANDOM AND PERIODIC
The total LF noise should be measured peak-to-peak in the frequency band 40 Hz–7·5 kHz.

d LF RANDOM
Measurement is made peak-to-peak within the band 40 Hz–7·5 kHz, as above, but using a comb filter to attenuate periodic components. Care should be taken to compensate for any effects of field gating on the measurement. If the signal being fed to the detector is examined on an oscilloscope at field rate it will be seen that the waveform contains spikes due to field blanking. The reading should be corrected to allow for this. For instance, if the oscilloscope gain is adjusted to make the blanking spikes 10 cm on the display and the general noise peaks are 5 cm, then the measured reading should be reduced by 6 dB.

e MOIRÉ AND CHROMINANCE MODULATION NOISE
Moiré measurements are made by using 100% colour bars as the test signal (Section 9, Ref.8). The VTR replay output is fed to a PAL decoder and the RED output measured on an RMS noise measuring set over a frequency band of 0–3 MHz. The figure obtained is increased by 8 dB to convert to peak-to-peak and to allow for the weighting of the decoder. Each colour bar is sampled in turn in the middle of the bar and the worst figure is taken as the result.

One hundred per cent saturated full field Y,C,G,M,R,B, colours may be used instead of colour bars.

Moiré may also be measured on a spectrum analyser. An assessment of the combined effect can be obtained by a square law addition of the individual components.

AUDIO MEASUREMENTS

3.2.6 Output Signal Level

a Signal level should be measured at the output after line-up using the EBU alignment tape or a recording made to the same standard.

b GAIN STABILITY
The greatest change occurring in the output level throughout a period of one hour, using the same recording.

3.2.7 Amplitude/Frequency Response

The input level to the recorder should be − 10 dBu. As this test is a measurement of the variation of gain of the equipment with frequency, corrections should be made for any variation of the input level with frequency.

Tests should be made at the following frequencies and the measurements should be referenced to the level at 1 kHz: 40 Hz, 60 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 6 kHz, 8 kHz, 10 kHz, 12 kHz, 15 kHz.

Additional tests should be made to ensure that the overall response falls smoothly outside this frequency band.

3.2.8 Total Harmonic Distortion

The input level to the VTR should be + 8 dBu at each frequency.

3.2.9 Signal/Noise Ratio

The noise levels are measured by using a test set incorporating a standard PPM (to BS4297) and a low-noise amplifier with calibrated variable gain.

The 'unweighted' bandwidth is limited to the range 22·4 Hz–22·4 kHz by a bandpass filter, and the 'weighted' frequency response is determined by the CCIR network, as defined in Rec.468-1. The frequency response of this network is shown in Section 9, Ref.9.

With the VTR under test lined-up to its normal gain

setting, it is first supplied with 1 kHz tone at 0 dBu and a recording is made. The input signal is then replaced by a 600 ohm termination and a further recording is made.

The output of the VTR is connected to the test set and the recordings are played back. The gain of the test set is adjusted so that, on the first recording, the PPM gives a scale reading of '4' (i.e., 0 dBu); with the second recording, the gain of the test set is readjusted so that the PPM again peaks to a scale reading of '4'. The signal/noise ratio is the difference between the two settings of the test set gain.

3.2.10 Wow and Flutter

Measurements are made by first recording a test frequency of 3·15 kHz at standard reference level. On replay, wow and flutter amplitudes should be measured by use of an instrument complying with IEC Publication 386, the relevant portions of which are reproduced in Section 9, Refs. 10a & 10b.

Section 4 – Audio Recorders

PART 1 – PERFORMANCE REQUIREMENTS

4.1.1 Definitions and Operational Practice

Tolerances are given for sprocketed sound followers, high quality tape recorders and less high quality tape equipments.

'High quality' tolerances apply to equipments, including multi-track recorders, used for the recording and replaying of significant speech and music.

'Less high quality' applies to audio cartridge equipment for NAB Type B audio cartridges or similar equipment used for effects.

Tolerances listed refer to a single recording and replay not necessarily on the same machine.

Tape recorders and reproducers should preferably employ CCIR/IEC equalisation characteristics in accordance with IEC Publication 94, 3rd Edition, 1968.

Related tracks are defined as those which normally carry specific contributions to a composite sound track, such as the orchestral components of a musical balance.

Unrelated tracks are defined as those carrying information which is acoustically dissimilar, such as time-code or other synchronising signals, effects and foreign language tracks.

	SOUND FOLLOWERS	HIGH QUALITY	LESS HIGH QUALITY
4.1.1 (Omitted)			
4.1.2 Output Signal Level			
a Insertion Gain Adjustment Error	± 1·0 dB	± 1·0 dB	± 1·5 dB
b Gain Stability*	± 0·5 dB	± 0·5 dB	± 1·0 dB
4.1.3 Amplitude/Frequency Response			
a 40 Hz to 15 kHz wrt 1 kHz	+ 1·5 dB − 2·5 dB	+ 1·5 dB − 2·5 dB	+ 1·5 dB − 2·5 dB
b 125 Hz to 10 kHz wrt 1 kHz	± 1·5 dB	± 1·0 dB	—
4.1.4 Signal/Noise Ratio			
a Weighted, Random, Peak	40 dB	40 dB	36 dB
b Unweighted, Random, Peak	45 dB	45 dB	40 dB
4.1.5 Interchannel Crosstalk			
a Related tracks, unweighted, peak 40 Hz to 15 kHz*	—	40 dB	40 dB
b Unrelated tracks, weighted, peak*	—	50 dB	50 dB
4.1.6 Total Harmonic Distortion			
a 1 kHz at + 8 dBu	3%	2%	4%
b 80 Hz at + 8 dBu	3%	2%	4%
c 1 kHz at − 10 dBu	3%	2%	4%
d 80 Hz at − 10 dBu	3%	2%	4%
4.1.7 Wow and Flutter			
Weighted, peak	0·15%	0·12%	0·15%

*Target tolerance not obligatory

PART 2 – TEST METHODS

4.2.1 (Omitted)

4.2.2 Output Signal Level

a INSERTION GAIN ADJUSTMENT ERROR

The Insertion Gain Adjustment Error is the difference between the input and output levels at 1 kHz. The measurement should be made with an input level of 0 dBu.

b GAIN STABILITY

The greatest change occurring in the output level throughout a period of one hour, using the same recording.

4.2.3 Amplitude/Frequency Response

The input level to the recorder should be – 10 dBu. As this test is a measurement of the variation of gain of the equipment with frequency, corrections should be made for any variation in the input level with frequency.

Tests should be made at the following frequencies and the measurements should be referenced to the level at 1 kHz: 40 Hz, 60 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 6 kHz, 8 kHz, 10 kHz, 12 kHz, 15 kHz. Additional tests should be made to ensure that the overall response falls smoothly outside this frequency band.

4.2.4 Signal/Noise Ratio

The noise levels are measured by using a test set incorporating a standard PPM (to BS4297), and a low-noise amplifier with calibrated variable gain. The 'unweighted' bandwidth is limited to the range 22·4 Hz to 22·4 kHz by a bandpass filter, and the 'weighted' frequency response is determined by the CCIR network, as defined in Rec.468-1. The frequency response of this network is shown in Section 9, Ref.9.

With the machine under test lined-up to its normal gain setting, it is first supplied with 1 kHz tone at 0 dBu and a recording is made. The input signal is then replaced by a 600 ohm termination and a further recording is made. The output of the machine is connected to the test set and the recordings are played back. The gain of the test set is adjusted such that, on the first recording, the PPM gives a scale reading of '4' (i.e., 0 dBu); with the second recording, the gain of the test set is readjusted so that the PPM again peaks to a scale reading of '4'. The signal/noise ratio is the difference between the two settings of the test set gain. The measurements are made both weighted and unweighted.

4.2.5 Interchannel Crosstalk

If guard tracks are normally used between certain recorded tracks, this factor will be taken into account.

a RELATED TRACKS

Test signals should be recorded on one track and the input to each adjacent recording track should be terminated in 600 ohms. The input level to the recorder should be – 10 dBu and signals at the following frequencies should be recorded: 40 Hz, 250 Hz, 1 kHz, 6 kHz, 12 kHz, 15 kHz.

Measurements should be made on the output of the interfering track and on an adjacent recorded track using the test set required for signal/noise measurements. The 'unweighted' condition should be selected and additional bandpass filtering will be necessary. The difference between these two readings is the interchannel crosstalk.

b UNRELATED TRACKS

A test signal, time code or other synchronising signal should be recorded on one track and the input to each adjacent recording track should be terminated in 600 ohms. The test signal should be either 7 kHz at a level of – 10 dBu or, in the case of the time code or other synchronising signals, at the normal operational level.

Measurements should be made on the output of the interfering track and of an adjacent recorded track using the test set required for signal/noise measurements. The signal from the interfering track should be measured unweighted, but measurements on the adjacent tracks should be made weighted – using, in the case of the 7 kHz interfering signal, additional bandpass filtering to separate the interfering signal from the noise. The difference between these two readings is the interchannel crosstalk.

4.2.6 Total Harmonic Distortion

The input level to the recorder should be + 8 dBu and – 10 dBu at each frequency.

4.2.7 Wow and Flutter

Wow and flutter should be measured at a test frequency of 3·15 kHz. On replay, wow and flutter amplitudes should be measured by use of an instrument complying with IEC Publication 386, the relevant portions of which are reproduced in Section 9, Refs. 10a & 10b.

A recorder-reproducer should be measured by recording a 3·15 kHz test frequency, and subsequently reproducing this recording and measuring the total wow and flutter. Only in the case of tape delay machines should wow and flutter be measured while simultaneously recording and reproducing.

Section 5 – Television Cameras

PART 1 – PERFORMANCE REQUIREMENTS

5.1.1 Definitions and Operational Practices

The tolerances in this Section are related to general purpose studio and OB cameras. Equipment for specific purposes, such as clock scanners, are required to meet a subjective performance limit of 4-star or better.

The cameras should be set-up for the following tests according to the normal procedures of the programme contractor. Controls should be readjusted subsequently only as required to perform the test.

a Iris – same as needed to produce 100% output from a 60% reflectance neutral surface under normal studio lighting.

b Zoom angle – the test shall be applied at a non-extreme setting.

c Aperture correction and contours – adjusted as for normal studio use.

d Gamma correction – 0.45 (nominal).

e Flare correction – in circuit.

f Matrix – in circuit.

g Measurement zones – in the following tests 'inner zone' refers to the area defined in Section 9, Ref.17.

5.1.2 Stability

No parameter should exceed the standard limits at any time during two hours immediately following line-up.

5.1.3 Black Shading	
a Inner zone – luminance	3%
b Inner zone – colour separation difference	1%
c Overall (whole field) – luminance	5%
d Overall – colour separation difference	2%
5.1.4 White Shading	
a Inner zone – luminance	5%
b Overall (whole field) – luminance	10%
c Overall – colour separation signals:	Green 5%*
	Red 7%*
	Blue 7%*

* Not more than half these amounts may be exceeded in any 10% of picture height or width.

5.1.5 Resolution	
a Centre (0·5–5·0 MHz)	100 ± 20%
b Corners (5·0 MHz)	40%–110% of centre
5.1.6 Waveform Response	
a Negative pulse maximum overshoot or pre-shoot	25% of pulse height
b Pre-shoot minus overshoot	0 ± 10% of pulse height
5.1.7 Geometry	
a Inner zone	1% of picture height
b Whole field	2% of picture height
5.1.8 Registration	
a Inner zone	0·15% of picture height
b Whole field	0·4% of picture height

5.1.9 Latent and Spurious Images	
a Line Scan Ringing	5%
b Blemishes, tube spots and other defects	Impairment level 4 (Section 9, Ref.18)
5.1.10 Streaking	
a Short-term luminance	1%
b Short-term colour separation difference	Less than 1%
c Long-term luminance	2%
d Long-term colour separation difference	1%
5.1.11 Flare†	
a DC Flare	± 2%
b AC Flare	± 7%
5.1.12 Greyscale	
Differential error between any Y,R,G or B, signals in a single studio, OB vehicle or combination of sources used to contribute to single productions	2%
5.1.13 Noise	
a Weighted Luminance (RMS)	−48 dB
b Weighted Chrominance (RMS)	−43 dB
c Total Low Frequency Random and Periodic (p–p)	−45 dB
d Low Frequency Random (p–p)	−52 dB
5.1.14 Lag†	
a Green channel	7%
b Colour separation difference signals	3%

† Target tolerance not obligatory.

PART 2 – TEST METHODS

5.2.1
5.2.2 } **(Omitted)**

5.2.3 Black Shading

The measurements are best made with the camera lens capped. Lift of 5% is introduced in the centre of the picture so that the outputs are clear of black clipping effects. The luminance shading is measured on the encoder output. (Chrominance may be switched off for a clearer display.) The colour separation difference signals G–R, G–B and R–B, are measured on the camera outputs, each result being expressed as a percentage of the nominal peak output of the camera.

The inner zone is best identified by using an active picture area generator. Where this is not available a white card with the active picture area cut away (Section 9, Ref.16a) mounted on a deep, black felt-lined box can be used. The card is illuminated so that no light falls on the rear of the box, and the iris is adjusted to give approximately 10% output from the white card. This is enough to distinguish the inner zone without incurring significant amounts of flare or streaking. For colour separation difference measurement a minor adjustment of red or blue gain may be used to separate the inner zone from the surround.

5.2.4 White Shading

Great care must be taken to ensure a very even illumination of a 60% reflectance neutral card. Natural daylight is one of the most reliable sources. In studios, an integrating sphere can provide an area of very even luminance. Otherwise, it is best to light a test card, of full size, but to use only part of the area by zooming in and defocusing (provided that an active picture area generator can be used to separate the inner zone).

The camera should be adjusted so that the red, green and blue signals each achieve 100% in the centre. Care should be taken that no part of the picture is affected by white clipping circuits. Luminance shading is measured on the encoder output (chrominance may be switched off for a clearer display).

The R, G and B signals are measured on the camera outputs.

The inner zone is best identified by using an active picture area generator. Where this is not available a white card with the outer zone black must be used (Section 9, Ref.16b). Lamp shading may place limitations on the accuracy of measurement, especially for the whole field result. The measuring of colour differential shading may be assisted by a minor maladjustment of R or B black level to distinguish the outer zone.

5.2.5 Resolution

a CENTRE

A test transparency having sinusoidal resolution gratings, such as Test Charts 52 or 60 (Section 9, Ref.16c), is evenly illuminated and correctly framed. With gamma correction set to the normally used value, the black and white reference blocks respectively are adjusted by means of lift and iris controls to 175 mV and 525 mV above blanking level.

Each resolution grating in the range 0·5 MHz–5·0 MHz is measured at the coder output and is expressed as a percentage of the reference black-to-white transition, after correction circuits have been adjusted for a flat response.

b CORNER

The 5 MHz (400 lines) grating is positioned by means of the camera pan and tilt controls such that it lies just outside the boundary of the inner zone along the picture diagonals. Thus, four measurements are made and the peak-to-peak amplitudes are recorded as percentages of the value achieved at the centre.

The use of Test Card 60 will render unnecessary any movement of the camera since the 5 MHz corner gratings on this chart are ideally positioned (i.e., on the picture diagonals and immediately outside the inner zone).

5.2.6 Waveform Response

The waveform response is determined by measuring the pre-shoot and overshoot produced when the camera scans a white-on-black transient such as that on Test Chart 60 (between the 2 MHz and 4 MHz resolution gratings).

The camera should be correctly framed and exposed for Test Chart 60 (or equivalent chart) such that the black and white reference areas respectively produce levels of 175 mV and 525 mV above blanking level.

Registration controls should be optimised for the best pulse shape. Misregistration can severely affect the results.

Measurements are made at the coder output.

5.2.7 Geometry

A suitable grid test chart (Section 9, Ref.16d) should be placed in front of the camera, care being taken to ensure that the plane of the test chart is orthogonal to the camera taking lens axis and that the vertical axis is truly vertical. When necessary, a plumb line should be used. The test chart should precisely fill the scanned area.

The camera output is then combined with an electronically generated grid pattern having the same number of horizontal and vertical lines and the combination is displayed on a black-and-white picture monitor.

If the test chart is equipped with calibration circles, the measurement is best made by superimposing in turn each part of the picture from the camera with its counterpart in the electronic pattern, and reading off the amount by which the reference point on the centre of the picture has been misplaced. Otherwise, an estimate of the error is made as a proportion of one square. The result is expressed as a percentage of picture height.

If a particularly accurate measurement is required, the green tube is compared with the electronic grid and the shift potentiometer is used to superimpose the grids at each point. The change in voltage, expressed as a fraction of the voltage change for one square, is used to calculate the result in the same way as for registration measurement (see below). If both horizontal and vertical errors exist at the same point, the separate horizontal and vertical measurements are summed vectorially to produce the result.

5.2.8 Registration

After alignment the camera may be moved before the tests are applied.

A suitable grid pattern chart is used for the tests (Section 9, Ref.16d). The camera signal outputs are displayed differentially on a black-and-white picture monitor, and the green channel horizontal and vertical shift potentiometers are used in turn to correct the largest registration errors in the inner and outer zones. Measurement is made of the change of each shift potentiometer voltage and is expressed as a fraction of the voltage change for one square. The results are expressed as a percentage of picture height.

If both horizontal and vertical errors exist at the same point the result should be summed vectorially.

5.2.9 Latent and Spurious Images

The intention is to include in this Section any defect not covered by other measurements. Where possible, objective measurements also should be used.

Line scan ringing should be measured by using the same test conditions as for black shading.

Impairment level 4 on the 5-point scale is defined as: 'perceptible but not annoying' (Section 9, Ref.18).

5.2.10 Streaking

a & *b* SHORT-TERM

A test chart such as the one shown in Section 9, Ref.16e is used in conjunction with a black felt-lined

box. The white part of the chart is set to nominal peak output on the luminance channel and the black hole is set to be just clear of black clipping.

Short-term streaking is defined as the disturbance resulting from the white bar to camera output signal corresponding to the hole in the chart. The camera luminance signal is displayed on a waveform monitor at line rate and the change in level of the black hole during the lines which scan the white bar is measured and expressed as a percentage of the nominal peak signal. The first 0·625 µs after the transition from white to black is considered as a function of resolution and, for the purpose of this measurement, is ignored.

Colour streaking is measured by using the camera output signals. Separate measurements G–R, G–B and R–B, should be made. A line strobe may be found useful in separating the wanted signal from the general background.

c & *d* LONG-TERM

A suitable test chart is shown in Section 9, Ref. 16f. Black level and iris are adjusted such that the black holes give an output of nominally black level and the white patches give 100% of the peak signal.

The level of the background can be affected by both flare and streaking. The streaking is measured by comparing a line following the white patch with the equivalent line before the white patch. The greatest difference in amplitude is expressed as a percentage of the black-to-white transition. Any variation during the first two lines after the transition, due to vertical aperture correction, should be ignored.

5.2.11 Flare

In addition to the following, alternative methods of measurement are acceptable.

A test card of 99% average picture level (Section 9, Ref. 16h) is mounted in a black felt-lined box and illuminated under typical studio lighting conditions. The resulting peak video level is set to 700 mV using the iris control. The zoom control is then adjusted so that the central hole of the test card fills the entire field. The lift is set to 5% (35 mV).

a DC FLARE

The zoom control is adjusted to make the width of the black area 70% of picture width. The difference between the level at the centre of the black area and the 35 mV lift is expressed as a percentage of 700 mV.

b AC FLARE

The zoom control is adjusted to make the width of the black area 10% of picture width. The difference between the level at the centre of the black area and the 35 mV lift is expressed as a percentage of 700 mV.

5.2.12 Greyscale

The purpose of this test is to establish the similarity of camera transfer characteristics and not the absolute characteristics. Nevertheless, the nominal value of gamma correction should be 0·45.

A test card such as that shown in Section 9, Ref. 16f is used in conjunction with a black felt-lined box.

On exposure to the test card, the super-blacks produced by the chart cut-outs should be set to blanking level using the master black level control (or individual controls, if necessary). The iris control (and individual channel gain controls, if necessary) should be adjusted such that the 60% reflectance chip produces an output of 700 mV (100%).

Using a waveform monitor with a line strobe facility, the amplitudes of the Y,R,G,B and encoded signals produced by chips 'a' and 'b' on the test chart are measured and recorded for every camera in the studio or OB unit.

5.2.13 Noise

Using a sine wave resolution test chart (Section 9, Ref. 16c) set the reference black and white areas to 175 mV and 525 mV above blanking level.

The resolution response of the camera channel is then adjusted by means of whatever aperture correction controls are available, so that the amplitude of the 3 MHz grating is 525 mV p-p and that of the 5 MHz grating is as near as possible to 350 mV p-p. This will facilitate the measuring of noise under conditions which approximate to normal practice.

Measurement is then made by using a neutral card with the iris adjusted to give an output of approximately 52% of white level. This should correspond to the point on the gamma correction curve at which the gain is unity. The lens may be zoomed in and defocussed to minimise shading.

a WEIGHTED LUMINANCE

Measurement is made in the band 7·5 kHz–5·0 MHz using RMS detection. The characteristic of the luminance weighting filter is shown in Section 9, Ref. 7.

b WEIGHTED CHROMINANCE

Measurement is made in the band 3·5 MHz–5·5 MHz as defined only by the characteristic of the weighting filter – shown in Section 9, Ref.7, and by using RMS detection.

c TOTAL LF, RANDOM AND PERIODIC

Measurement is made peak-to-peak in the band 40 Hz–7·5 kHz. Special care should be taken to avoid field shading on the card. It is suggested that the signal input to the detector should be examined on an oscilloscope and, if field shade is present, any correction should be made to the illumination or the camera field shading correctors, if fitted.

d LF RANDOM

Measurement is made as for (*c*) above but using a comb filter to attenuate periodic components. Care must be taken to compensate for any effects of field gating on the measurement. If the detector input signal is examined on an oscilloscope [as in (*c*) above] field blanking spikes may be seen. If they are significant the reading should be corrected. For instance, if the oscilloscope gain is adjusted to make the blanking spike 10 cm on the display and the general noise peaks are 5 cm, the measured reading should be reduced by 6 dB.

5.2.14 Lag

Lag may be defined as the difference in level, at the camera output, between that which exists at 100 ms after the end of a defined exposure and that finally achieved.

One method of measurement is as follows. The camera is arranged to scan a uniformly illuminated diffuse field via a shutter capable of terminating the exposure in a maximum period of 20 ms. With the shutter closed the lift of each output is set to 5% (35 mV). With the shutter open the iris is adjusted to give an output of 700 mV (100%) at each output. The camera output is displayed on a storage oscilloscope with the time-base triggered by the shutter closure. Alternatively, the decay characteristic may be recorded by photographic means. Measurements are made on the luminance and/or green channel outputs and the B–G, R–G and B–R signals. Aperture correction should be switched off to minimise noise. Flare correction should be switched off to avoid distortion of black level.

Section 6 – Telecines and Sound Followers

PART 1 – PERFORMANCE REQUIREMENTS

6.1.1 Definitions and Test Conditions

Tolerances in this Section apply to telecine, slide scanners and replay-only sprocketed sound followers. Monochrome slide and caption scanners used with colour synthesizers are not covered by the tests but are required to meet a subjective performance limit of 4-star or better. Tape reproducers should preferably employ equalisation characteristics in accordance with IEC Publication 94, 3rd edition, 1968.

Equipment should be set-up for the tests according to the normal procedure of the programme contractor. Controls should be readjusted subsequently only as required to perform the test. Details of test methods are contained in Part 2.

a Gain or light control – should be adjusted to achieve a standard picture level output of 700 mV peak-to-peak for a film density of 0·35.

b Aperture correction – should be adjusted so that the 400-line output on 35 mm (300-line output on 16 mm) from the test film is equivalent to that of the low frequency transitions. Specifying the use of sine wave resolution test film, when such film becomes available, is intended.

However, it is recognised that film used operationally may have a response less than this test film; therefore, the aperture corrector should be capable of a correction 6 dB greater than that required to achieve the above response.

c Unless otherwise stated, the percentages in the following tests refer to peak white being 700 mV and equal to 100% where blanking level is 0%.

d Gamma Correction = 0·4 (nominal).

e Peak audio signal level (+ 8 dBu) should correspond to 100% modulation on optical tracks and to a recorded flux density of 405 nWb/m on magnetic tracks.

VIDEO TOLERANCES

6.1.2 Stability

No parameter should exceed the following limits at any time during two hours immediately following line-up.

6.1.3 Black Shading

a Inner zone – luminance	3%
b Inner zone – colour separation difference	1%
c Overall (whole field) – luminance	5%
d Overall – colour separation difference	2%

6.1.4 White Shading

a Inner zone – luminance	5%
b Overall (whole field) – luminance	10%
c Overall – colour separation signals	Green 5%* Red 7%* Blue 7%*
d White clipper operation	To operate between 100% and 105% with negligible difference between channels.

* Not more than half these amounts may be exceeded in any 10% of picture height or width.

6.1.5 Flicker (Flying Spot types)	
a Inner zone – luminance	1%
b Overall (whole field) – luminance	2%
c Overall – colour separation signals	Green 3% Red 4% Blue 8%
6.1.6 Resolution (to 400 lines for both 35 mm and 16 mm film)	
a Centre	100 ± 20%
b Corners	40%–110% of centre amplitude
c Difference between fields (Flying Spot) – centre	10%
d Difference between fields (Flying Spot) – corner	20%
6.1.7 Waveform Response	
a Negative pulse maximum overshoot or pre-shoot	25% of pulse height
b Pre-shoot minus over-shoot	0 ± 10% of pulse height
6.1.8 Noise	
a Weighted Luminance (RMS)	– 50 dB
b Weighted Chrominance (RMS)	– 44 dB
c Total Low Frequency Random and Periodic (p–p)	– 47 dB
d Low Frequency Random (p–p)	– 55 dB
6.1.9 Geometry	
a Inner zone	1% of picture height
b Whole field	2% of picture height
c Difference between adjacent intervals	10% of an interval
6.1.10 Registration (camera types)	
a Inner zone	0·15% of picture height
b Whole field	0·5% of picture height
6.1.11 Interlace	40% : 60%
6.1.12 Interfield Registration (Flying Spot types)	
a Centre	Errors imperceptible
b Corners	0·05% of picture height
6.1.13 Streaking	
a Short-term Luminance	1%
b Short-term colour separation difference	Less than 1%
c Long-term Luminance	2%
d Long-term colour separation difference	1%
6.1.14 Flare	
a DC Flare	*
b AC Flare	*
6.1.15 Picture Steadiness	
P–P Vertical and Horizontal Hop and Weave	0·2% of picture height This limit should not be exceeded more than 3 times per minute and the hop and weave should never exceed twice the limit.

* At the first inspection of newly installed telecines, the AC and DC flare will be measured; these initial figures will be noted in the report documents. At subsequent inspections the change in flare performance will be measured. Although stipulation of an absolute figure for flare performance is thought desirable, it would at present be premature.

AUDIO TOLERANCES	COMOPT	COMMAG SEPMAG
6.1.16 Output Signal Level		
a Tolerance on signal level at o/p of machine after line-up	$\pm 0{\cdot}75$ dB	$\pm 0{\cdot}75$ dB
b Output level stability	2 dB	2 dB
6.1.17 Amplitude/Frequency Response		
a 60 Hz–8 kHz wrt 1 kHz	$^{+1\text{ dB}}_{-3\text{ dB}}$ or ± 2 dB	—
b 40 Hz–14 kHz wrt 1 kHz	—	$+1{\cdot}5$ dB $-2{\cdot}5$ dB
c 125 Hz–10 kHz wrt 1 kHz	—	$\pm 1{\cdot}0$ dB
6.1.18 Total Harmonic Distortion		
a 1 kHz at + 8 dBu	3%	3%
b 80 Hz at + 8 dBu	3%	3%
c 1 kHz at − 10 dBu	3%	3%
d 80 Hz at − 10 dBu	3%	3%
6.1.19 Signal/Noise Ratio		
a M/c running, open gate, Weighted, Random, Peak	50 dB	—
b M/c running, open gate, Unweighted, Random, Peak	55 dB	—
c Buzz Track	30 dB	—
d Weighted, Random, Peak	—	40 dB
e Unweighted, Random, Peak	—	45 dB
6.1.20 Wow and Flutter		
Weighted, Peak	0·15%	0·15%

PART 2 — TEST METHODS

VIDEO MEASUREMENTS

6.2.1
6.2.2 **(omitted)**

6.2.3 Black Shading (camera types)

Measured with the lamp off, 5% of lift is introduced in the centre of the picture so that the outputs are clear of black clipping effects. The luminance shading is measured on the encoder output (chrominance subcarrier may be switched off for a clearer display). The difference signals, G–R, G–B and R–B, are measured on the telecine output, all results being expressed as percentages of the nominal peak output (700 mV). The inner zone is identified by using an active picture area generator which complies with BS5115.

6.2.4 White Shading
6.2.5 Flicker (Flying Spot types)

Measurements are made 'open gate' with the mechanism running. The output level controls are adjusted so that the red, green and blue signals each achieve 100% (700 mV) in the centre. Care should be taken to ensure that no part of the picture is affected by white clipping circuits. Luminance shading is measured on the encoder output (for a clearer display, chrominance subcarrier may be switched off or the waveform monitor may be switched to a band limiting mode). The red, green and blue signals are measured on the telecine outputs. The inner zone is best identified by using an active picture area generator which complies with BS5115.

On Flying Spot telecines, the odd and even fields are examined separately. For any position, the average of the two fields is taken as the shading, and the maximum difference at any point between the two fields is taken as the flicker.

6.2.6 Resolution

It is intended to specify a sine wave test method when suitable test film becomes available; meanwhile, tests should be made with a square wave pattern such as Marconi Test Film No.1.

Lift and gain are adjusted so that the central LF transition corresponds with a voltage excursion from 25% to 75% video level. The response from other frequency gratings is compared with that of the LF transition.

Limits are quoted for a 'machine running' condition.

Correction for the shading performance may be necessary when measuring corner resolution.

On flying spot telecines the odd and even fields should be measured separately with the film running and the worst figure taken as a result.

6.2.7 Waveform Response

It is intended to specify the use of a test film having a white pulse on a dark grey background and a black pulse on a light grey background when such a test film becomes available. Meanwhile, the test should be made by using the Marconi Test Film No. 1 with the telecine running. Lift and gain should be so adjusted that large area blacks produce 5% video level and large area whites produce 55% video level. A line just above the upper frequency wedges should be strobed to measure the amplitude of the pre-shoot which occurs just before the negative going pulse produced by a black vertical line. Also, the amplitude of the overshoot which occurs just after the negative going pulse, and the amplitude of the negative going pulse, should be measured.

NB. On camera type telecines misregistration can affect the results. Therefore, measurements should be made on the GREEN channel.

6.2.8 Noise

Measurement is made by using a test film or slide of neutral density 1·07. This should give an output of approximately 52% of peak white and should correspond to the point on the gamma correction curve at which the gain is unity.

The red and blue gains are adjusted, if necessary, for optimum balance at this level. The following measurements are made:

a WEIGHTED LUMINANCE

Measurement is made in the band 7·5 kHz–5·0 MHz using RMS detection. The characteristic of the luminance weighting filter is shown in Section 9, Ref.7.

b WEIGHTED CHROMINANCE

Measurement is made in the band 3·5 MHz–5·5 MHz as defined only by the characteristic of the weighting filter shown in Section 9, Ref.7, and using RMS detection.

c TOTAL LF RANDOM AND PERIODIC

The total LF noise should be measured peak-to-peak in the frequency band 40 Hz–7·5 kHz. Care should be taken to ensure that the measurement is not affected by field shading signals.

d LF RANDOM

The peak-to-peak amplitude of random noise should be measured in the frequency band 40 Hz–7·5 kHz, using a comb filter to attenuate periodic components.

Care should be taken to compensate for any effect of field gating on the measurement. If the signal being fed to the detector is examined on an oscilloscope it will be seen that the waveform contains spikes due to field blanking. The reading should be corrected to allow for this. For instance, if the oscilloscope gain is adjusted to make the blanking spikes 10 cm on the display and the general noise peaks are 5 cm, then the measured reading should be reduced by 6 dB.

6.2.9 Geometry

A suitable grating test film having about 25 vertical and 25 horizontal intervals is run in the telecine. The ouput of the telecine is combined with an electronically generated grid pattern, having the same number of horizontal and vertical lines, and the combination is displayed on a picture monitor. An estimate of the error is made as a proportion of one interval and the result is expressed as a percentage of picture height.

Small adjustments to vertical scan amplitude are permissible during this test.

6.2.10 Registration (camera types)

A suitable grating test film having about 25 vertical and 25 horizontal intervals is run in the telecine. The signal outputs are displayed differentially on a black and white picture monitor and the green channel horizontal and vertical shift potentiometers are used in turn to correct the largest registration errors in the inner and outer zones. Measurements are made of the change of shift potentiometer voltage in each case and expressed as a fraction of the voltage change for one square. The result is expressed as a percentage of picture height.

If both horizontal and vertical errors exist at the same point the results should be summed vectorially.

6.2.11 Interlace

With the SMPTE Alignment and Resolution Pattern (Section 9, Ref.15) in the gate and the film stationary, the structure of the near horizontal lines of one of the vertical resolution test wedges (see Plate 6.1) is examined on a picture monitor. The interlace performance of the picture monitor is unimportant.

On the picture monitor screen (or photograph of it such as Plate 6.1), the horizontal distance between the left-hand edge of one white element and the left-hand edge of the next element to the right (i.e., on the other field) should be measured. This distance is referred to as 'A' in Fig. 6.1.

Next to be measured is the horizontal distance between the left-hand edge of the second element mentioned above and the left-hand edge of the next element to the right of that second element (i.e., on the same field as the first element). This distance is referred to as 'B' in Fig. 6.1.

For telecines where none of the vertical scan is produced by the film motion, the interlace ratio is:

$$\frac{A}{A+B} : \frac{B}{A+B}$$

or, the required standard of 40 : 60 may be expressed:

$$1{\cdot}5 > \frac{A}{B} > 0{\cdot}67$$

For telecines where approximately half the vertical scan is produced by film motion (twin lens or hopping patch machines) the required standard may be expressed:

$$2{\cdot}3 > \frac{A}{B} > 0{\cdot}43$$

6.2.12 Interfield Registration (Flying Spot types)

The SMPTE Alignment and Resolution Pattern (Section 9, Ref.15) should be running in the telecine.

a VERTICAL INTERFIELD REGISTRATION

Provided that the horizontal component of error is small compared with the vertical component, the method of measurement described in para 6.2.11 may be applied to the near horizontal lines of the corners of the SMPTE test pattern.

The vertical interfield registration error is:

$$0{\cdot}174 \times \frac{(A-B)}{(A+B)} \text{ \% of picture height.}$$

The required standard of 0·05% of picture height is met if:

$$1{\cdot}81 > \frac{A}{B} > 0{\cdot}554$$

b HORIZONTAL INTERFIELD REGISTRATION

On a photograph of a picture monitor screen (such as Plate 6.2), at 400 lines in each corner, the horizontal component of the distance between the left-hand edge of a white picture element on one field and the left-hand edge of the corresponding element on the other field should be measured. This distance is referred to as 'L' in Fig. 6.2.

The horizontal distance between the left-hand edge of the first used element and the left-hand edge of the next element to the right on the same field is then measured. This distance is referred to as 'M' in Fig. 6.2.

The frequency of 400 lines in the corners is 4·6 MHz; so, horizontal misregistration:

$$= \frac{L}{M} \times 0{\cdot}55\% \text{ of picture height.}$$

The required standard of 0·05% of picture height is met if:

$$\frac{L}{M} > 0{\cdot}09$$

6.2.13 Streaking

a & *b* SHORT-TERM

A 'de-streak' test film, consisting of white horizontal bars of different length on a black background (Section 9, Ref.15) is used. The telecine controls are adjusted so that the white bars correspond with nominal peak output (700 mV) with the background clear of black clipping effects.

Short-term streaking is seen as either a positive or negative disturbance to the background following the white horizontal bars. The luminance signal is displayed on a waveform monitor at line rate and the change in level of the background after the white bar is expressed as a percentage of the bar amplitude.

Care is needed in separating the effects of streaking from those of flare. Using the waveform monitor in the line strobe mode the line selector is 'rocked' up and down to permit comparison of a strobed line through the white bar with one just below it. Each bar is assessed in turn and the worst result is quoted. Overshoot components on the luminance signal are ignored for the purpose of this measurement.

Colour streaking is measured by using the telecine output signals. If colour streaking is apparent, separate measurements of G–R, G–B and R–B should be made.

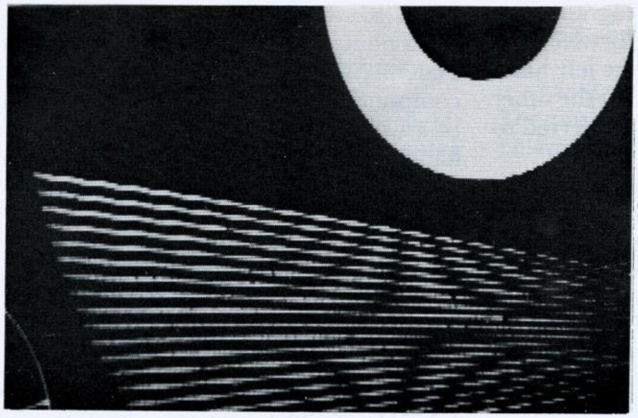


Plate 6.1

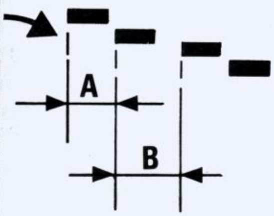


Figure 6.1

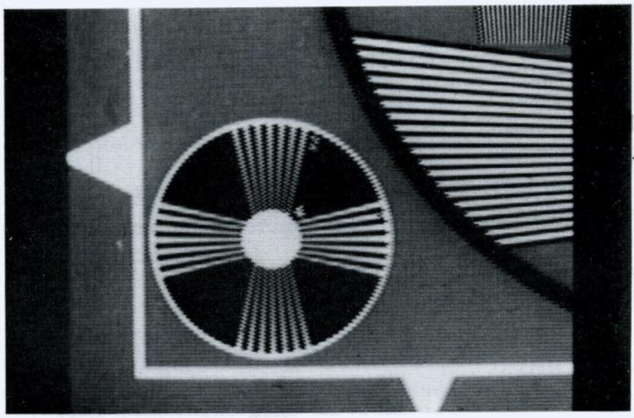


Plate 6.2

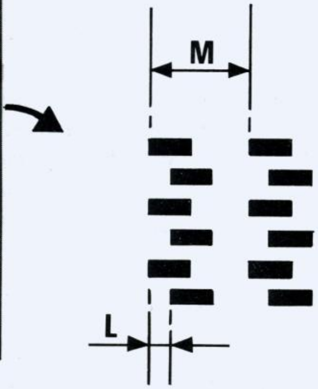


Figure 6.2

Enlargements of portions of SMPTE Test Chart

c & *d* LONG-TERM

A test film consisting of a white patch on a dark surround is used (Section 9, Ref.12). The telecine is adjusted to give peak signal output on the white patch with the background just above blanking level.

The luminance signal is observed at frame rate. The level of the background may be affected by both flare and streaking. The streaking is measured by comparing a line following the white patch with the equivalent line before the white patch. The greatest difference in amplitude is expressed as a percentage of the black-to-white transition. Any variation during the first two lines after the transition due to vertical aperture correction should be ignored.

6.2.14 Flare

In addition to the following, alternative methods of measuring are acceptable.

a DC FLARE

All flare correction circuitry should first be aligned according to normal station practice. The film gate is closed and the lift should then be set to 5% in order to avoid clipping or crushing.

A test film of 50% APL (Section 9, Ref. 13a) is then placed in the gate (certain twin lens machines will require a running loop to preserve the correct APL). The resulting video signal amplitude is then adjusted to 700 mV.

The level produced by the black area of the film is compared with the original 5% lift, and the DC flare is equivalent to this difference expressed as a percentage of 700 mV.

b AC FLARE

AC Flare (the halo surrounding bright objects) is measured by use of a test film of 99% APL (Section 9, Ref.13b).

The telecine gate should first be closed, and the lift set to 5%. The test film (still frame or running loop, as appropriate) is placed in the gate, and the video signal amplitude is adjusted to 700 mV. The level produced by the black area of the film is compared with the original 5% lift, and the AC Flare is equivalent to this difference expressed as a percentage of 700 mV.

6.2.15 Picture Steadiness

A test film similar to that listed in Section 9, Ref.15 can be used for this test; this film has a vertical stripe and a rectangle with upper and lower edges inclined at 15° to the normal.

To measure horizontal frame steadiness (weave), the line direction positional variation of a point (Section 9, Ref.14a.A) on the vertical stripe is measured by using external triggering of the delayed time-base of an oscilloscope with approximately 100 ns/cm magnification. The peak-to-peak weave of the point (ΔH_A) is measured in nanoseconds and expressed as a percentage of picture height. Thus:

$$\text{Weave p-p} = \frac{\Delta H_A}{520} \times \tfrac{4}{3}\% \text{ of picture height.}$$

The weave limit of 0·2% of picture height corresponds to a peak-to-peak timing jitter of 78 ns.

To measure the vertical frame steadiness (hop), a point (Section 9, Ref.14c.B) on the inclined edge of the rectangle is observed on an oscilloscope. The line rate mode, with internal triggering of the delayed time-base by the narrow vertical stripe, should be used. The maximum line positional variation of that point on the inclined edge (ΔH_B) is an indication of the vertical steadiness frame error. The hop referred to the picture height is:

$$\text{Hop p-p} = \frac{\Delta H_B\%}{1450} \; (\Delta H_B \text{ in ns})$$

The hop limit of 0·2% of picture height corresponds to a peak-to-peak timing jitter of 290 ns.

If the frame steadiness error of the test film is significant, it must be arithmetically deduced from the test measurements.

AUDIO MEASUREMENTS

6.2.16 Output Signal Level

a Suitable test films are listed in Section 9, Ref. 15.

b The wow and flutter test film should be replayed and the peak-to-peak variation in output during a one minute replay should be measured on a standard PPM (to BS4297).

6.2.17 Amplitude/Frequency Response

Suitable test films are listed in Section 9, Ref.15.

Measurements should be made with any Academy filter out of circuit.

6.2.18 Total Harmonic Distortion

Suitable test films are listed in Section 9, Ref.15.

At the lower levels the presence of noise might necessitate the use of selective filters to isolate the harmonic components.

6.2.19 Signal/Noise Ratio

The noise levels are measured by using a test set incorporating a standard PPM (to BS4297) and a low-noise amplifier with calibrated variable gain. The 'unweighted' bandwidth is limited to the range 22·4 Hz–22·4 kHz by a bandpass filter, and the 'weighted' frequency response is determined by the CCIR network, as defined in Rec.468–1. The frequency response of this network is shown in Section 9, Ref.9.

A line-up film, which produces an output of 0 dBu, should be replayed with the machine under test adjusted to its normal gain setting. The ouput of the machine is connected to the test set and the gain of the test set is adjusted so that the PPM gives a scale reading of '4' (i.e., 0 dBu).

For each of the following measurement conditions, the gain of the test set is readjusted so that the PPM again peaks to a scale reading of '4'. In each case the signal/noise ratio is the difference between the particular two settings of test set gain.

a & *b* Measurements should be made without film but otherwise under normal operating conditions, i.e., with machine running, doors closed and operating area lights on.

c Measurements should be made unweighted while playing a buzz track test film.

d & e Measurements should be made while playing erased magnetic film.
Suitable test films are listed in Section 9. Ref. 15.

6.2.20 Wow and Flutter

Wow and flutter amplitudes in the frequency range 200 mHz to 200 Hz should be measured peak weighted by using an instrument complying with IEC Publication 386 (CCIR Rec. 409–2) the relevant portions of which are reproduced in Section 9, Ref. 10b.

The specified figures should be achieved immediately after the run-up time used in normal operation.

Suitable test films are listed in Section 9, Ref. 15.

Section 7 – Disc Reproducers

PART 1 — PERFORMANCE REQUIREMENTS

7.1.1 Explanatory Notes

Reproducers fitted with variable speed control should be measured while having the control set for the nominal speed.

The pick-up head (mounted on the normal tone arm) and equalising amplifier are considered as being part of the signal chain.

7.1.2		**Amplitude/Frequency Response**	
		40 Hz–12·5 kHz wrt 1 kHz	± 2·5 dB
7.1.3		**Signal/Noise Ratio**	
	a	Weighted, Random, Peak	50 dB
	b	Unweighted, Random, Peak	55 dB
7.1.4		**Rumble**	
	a	Weighted	55 dB
	b	Unweighted	40 dB
7.1.5		**Intermodulation Distortion**	
		Frequency Intermodulation Distortion, Unweighted, Peak	5%
7.1.6		**Speed and Wow and Flutter**	
	a	Absolute speed	± 2·0%
	b	Wow and Flutter, Weighted, Peak	0·12%

PART 2 — TEST METHODS

7.2.1 (Omitted)

7.2.2 Amplitude/Frequency Response

Measurements should be made by using a standard PPM (to BS4297) while playing the mono side of a test record to DIN 45 541. (Note that the frequency range is covered in two bands, having different recorded levels — the appropriate 1 kHz level should be used.)

7.2.3 Signal/Noise Ratio

The noise levels are measured by use of a test set incorporating a standard PPM (to BS4297), and a low-noise amplifier with calibrated variable gain. The 'unweighted' bandwidth is limited to the range 22·4 Hz–22·4 kHz by a bandpass filter, and the 'weighted' frequency response is determined by the CCIR network as defined in Rec.468–1. The frequency response of this network is shown in Section 9, Ref.9.

The first band of the mono side of a test record to DIN 45 541 should be played and the test set should be connected to the output of the equipment. With the equipment under test adjusted to its normal gain, the test set is adjusted so that the PPM gives a scale reading of '4' (i.e., 0 dBu). A second measurement should be made with the turntable running and the pick-up arm on its rest; the gain of the test set is re-adjusted so the PPM again peaks to a scale reading of '4'. The signal/noise ratio is the difference in the settings of the test set gain. The measurements should be made both weighted and unweighted.

7.2.4 Rumble

The measuring instrument should comply with BS4852, the relevant details of which are given in Section 9, Ref.11.

The first track of Side 'A' of a test record to DIN 45 544 should be replayed and the measuring instrument should be connected to the output of the equipment. With the equipment under test adjusted to its normal gain, the gain of the measuring instrument should be adjusted to produce a scale reading of '0 dB'. The unmodulated track should then be played and the gain of the measuring instrument readjusted so that the meter again produces a scale reading of '0 dB'. The rumble is the difference in the settings of the measuring instrument gain. The measurements should be made both weighted and unweighted.

7.2.5 Intermodulation Distortion

The measurement of frequency intermodulation distortion should be made in accordance with the method described in DIN 45 411, i.e., the measuring instrument should be a wow and flutter meter complying with DIN 45 507 (equivalent to IEC Publication 386) in which the weighting filter has been replaced by a high-pass filter having a time constant of 1 ms.

Parts III and IV of Side 'B' of a test record to DIN 45 542 should be played, and the larger value of the distortion should be noted.

7.2.6 Speed and Wow and Flutter

Speed deviation and wow and flutter should be measured by using a test record to DIN 45 545.

The measuring instrument for wow and flutter should comply with IEC Publication 386 (CCIR Rec.409–2), the relevant portions of which are reproduced in Section 9, Ref.10b.

The record should first be centred with respect to the rotational axis of the turntable by playing the concentric groove near the edge and adjusting the position of the record to minimise lateral movement of the pick-up. The 3·15 kHz band should be played, and the wow and flutter should be measured at three positions across the band (largest radius, mid-radius and smallest radius). The largest value of wow and flutter should be noted.

Section 8 – Synchronising and Allied Waveforms

8.1 Television Waveforms

The waveforms leaving the television studio shall be in accordance with the specification for 625-line System I standards.

8.2 Teletext Signals

Radiated Teletext signals shall be in accordance with the British National Broadcast Teletext Specification.

8.3 Sound-in-Syncs

The Sound-in-Syncs signal contains bits as a two-level NRZ signal. One pulse group of twenty-one such bits is transmitted during one line sync period.

BIT RATE

The bit rate shall be 5·4974 Mbit/s, nominal.

PULSE SHAPE

The pulses representing the binary digits will be shaped to sine squared form with a half amplitude duration of 182 ns, nominal.

PULSE AMPLITUDE

The pulses will be inserted in the video waveform at an amplitude of 1V ± 30 mV and will be inserted 300 mV ± 9 mV below video black level. For satellite transmission the pulse amplitude is normally 700 mV.

PULSE GROUP DURATION

The total duration of the pulse group will be 3·82 μs ± 10 ns at the half-amplitude points.

SYNCHRONISING PERIOD WAVEFORM

The pulse group will be inserted into the video waveform in the position shown in Figure 8.1. In order to accommodate the pulses during the field blanking interval, line rate equalising pulses will be increased in width to approximately 4·5 μs. These equalising pulses will be restored to the correct width before radiation.

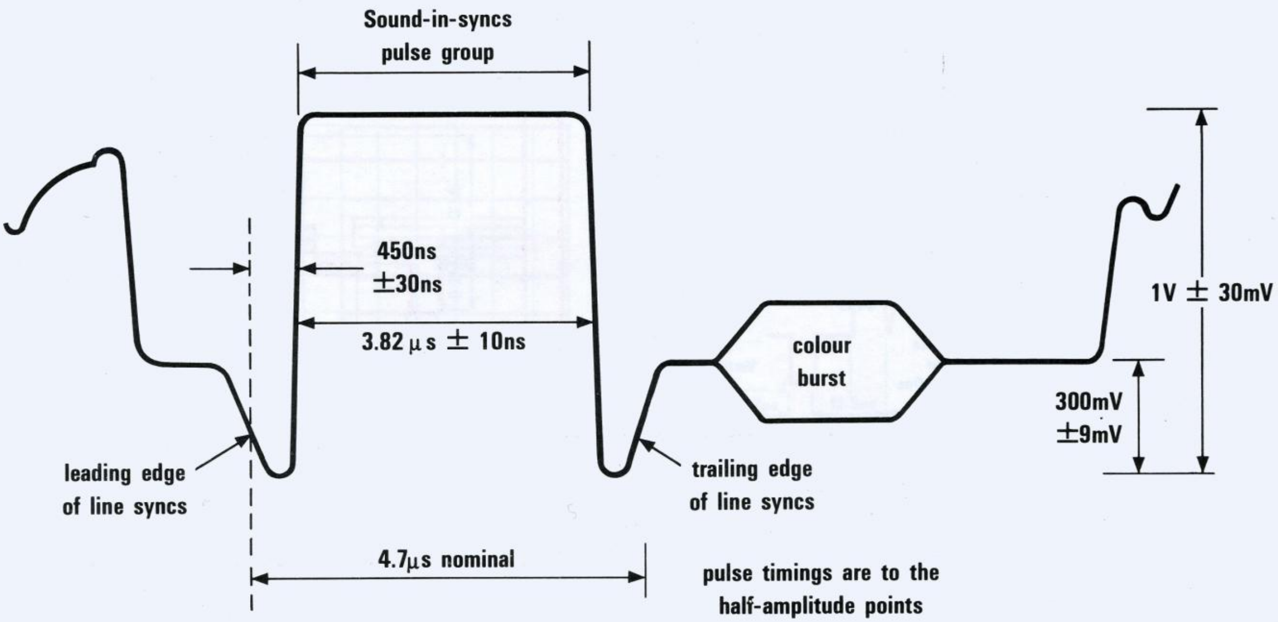
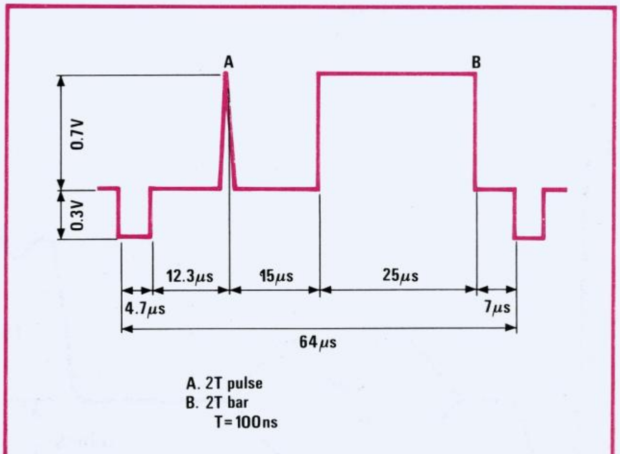


Fig. 8.1 — Sound-in-Syncs Signal

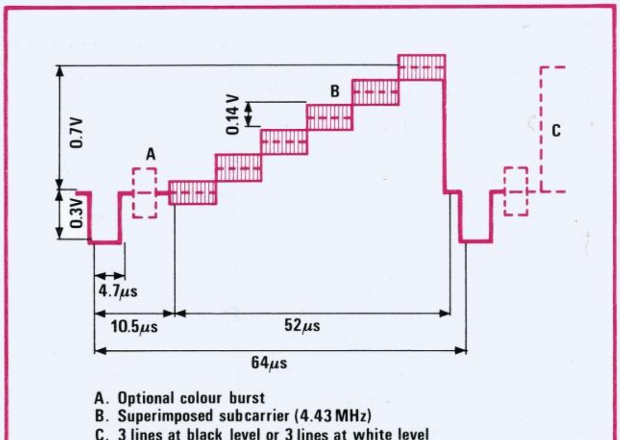
Section 9 – References

CONTENTS

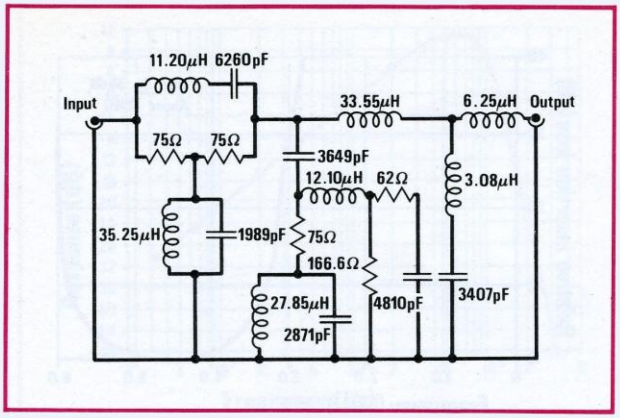


Note:– For the design of the shaping network, see: Macdiarmid and Phillips [1958] Proc. IEE, Vol. 105b, 440

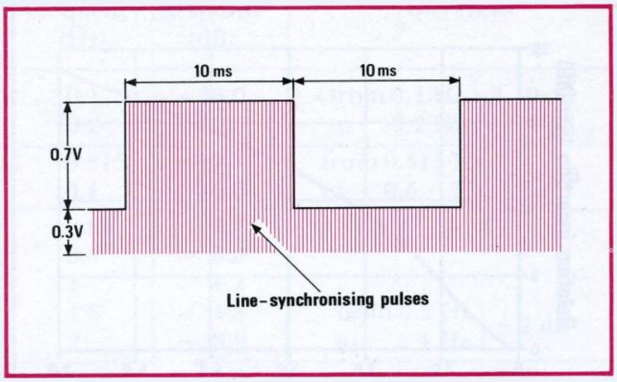
Reference 1 – 2T Pulse-and-Bar Test Signal (CCIR Rec. 451-2)



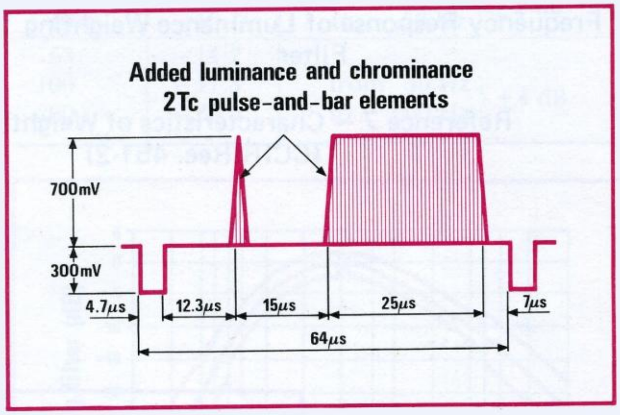
Reference 2 – Staircase Test Signal (CCIR Rec. 451-2)



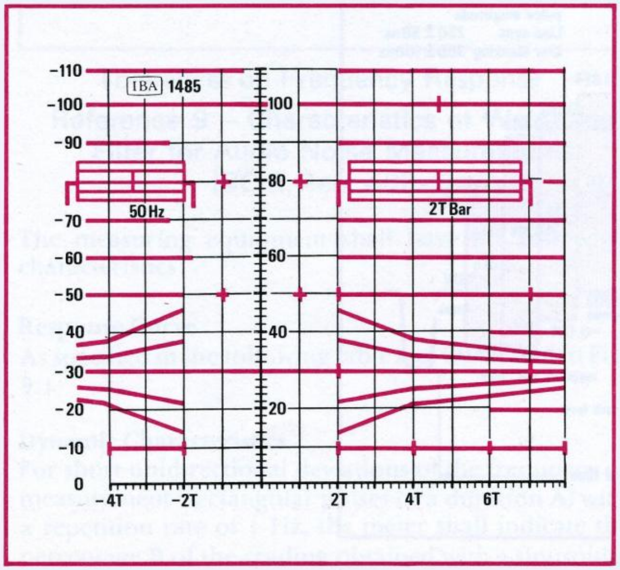
Reference 3 — Differentiating and Shaping Network



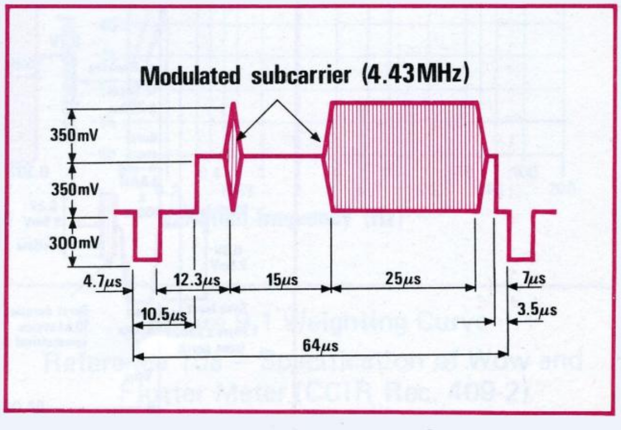
Reference 5 — 50Hz Square Wave Test Signal (CCIR Rec. 451-2)



Reference 6a — 2Tc Composite Pulse-and-Bar Test Signal

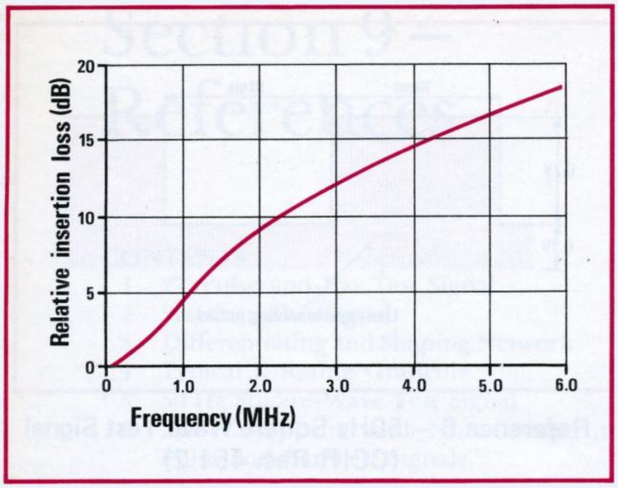


Reference 4 — Typical K-Rating Graticule

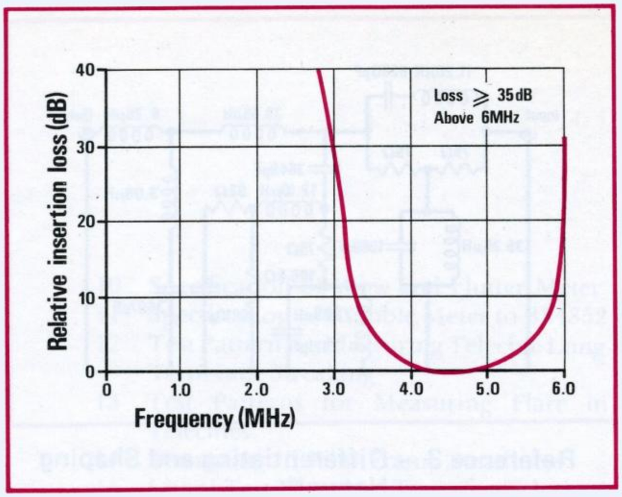


Reference 6b — 2Tc Non-Composite Pulse-and-Bar Test Signal

References 6a & 6b

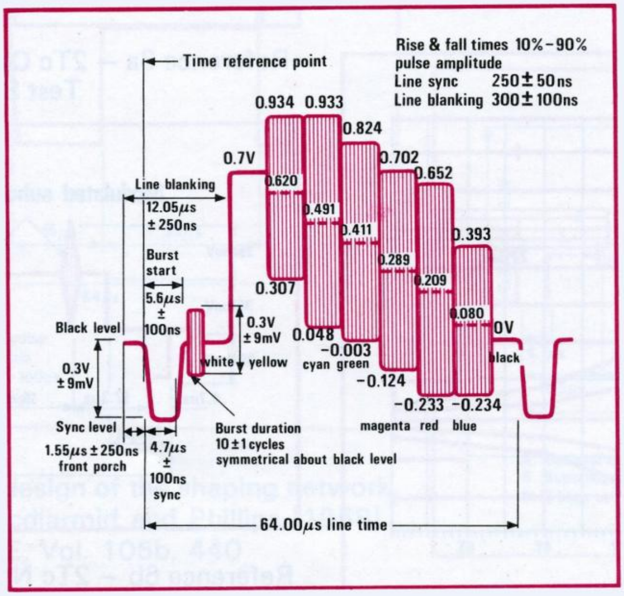


Frequency Response of Luminance Weighting Filter

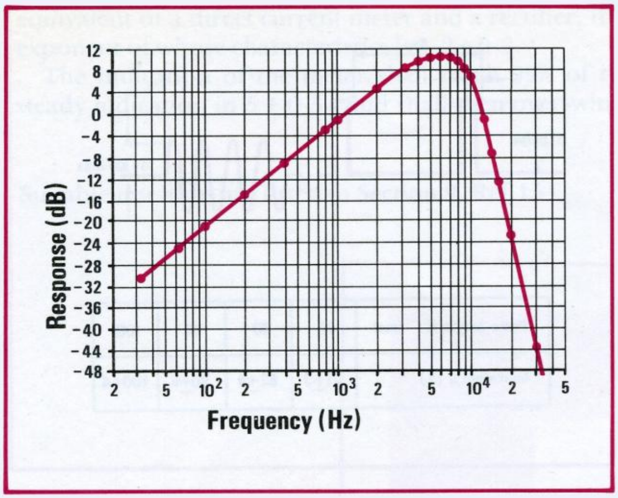


Frequency Response of Chrominance Weighting Filter

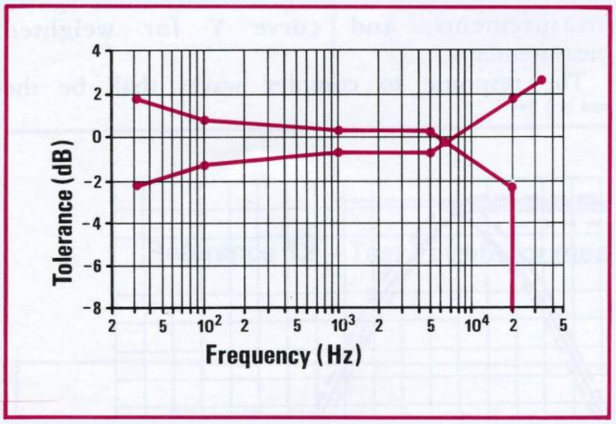
Reference 7 – Characteristics of Weighting Filters for Video Noise Measurements (CCIR Rec. 451-2)



Reference 8 – Waveform of 100.0.100.0 Colour Bars (100%)



Frequency Response



Tolerances on Frequency Response

Reference 9 – Characteristics of Weighting Filter for Audio Noise Measurements (CCIR Rec. 468-1)

The measuring equipment shall have the following characteristics:

Response Curve
As specified in the following table and illustrated in Fig. 9.1

Dynamic Characteristics
For short unidirectional deviations of the frequency of measurement (rectangular pulses of a duration A) with a repetition rate of 1 Hz, the meter shall indicate the percentage B of the reading obtained with a sinusoidal frequency modulation of 4 Hz having a peak-to-peak

Frequency (Hz)	Response (dB)	Tolerances
0.1	−48.0	from 0.1 Hz to 0.2 Hz: +10 dB / −4 dB
0.2	−30.6	
0.315	−19.7	from 0.315 Hz to 0.5 Hz: ±4 dB
0.4	−15.0	
0.63	− 8.4	from 0.5 Hz to < 4 Hz: ±2 dB
0.8	− 6.0	
1	− 4.2	
1.6	− 1.8	
2	− 0.9	
4	0	at 4 Hz ±0 dB
6.3	− 0.9	from > 4 Hz to 50 Hz: ±2 dB
10	− 2.1	
20	− 5.9	
40	−10.4	
63	−14.2	from 50 Hz to 200 Hz: ±4 dB
100	−17.3	
200	−23.0	

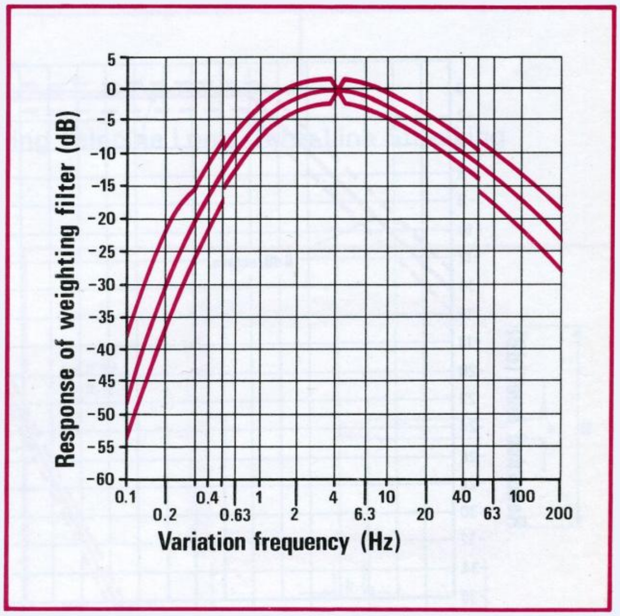


Figure 9.1 Weighting Curve

Reference 10a – Specification of Wow and Flutter Meter (CCIR Rec. 409-2)

deviation equal to the frequency swing of the pulse, that is (see Fig. 9.2):

$$\Delta f_{\text{pulse}} = 2\Delta f_{\text{sin max.}}$$

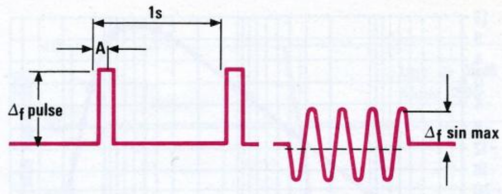
The return time shall be such that, when applying pulses of 100 ms duration with a repetition rate of 1 Hz, the meter shall indicate between 36% and 44% between the pulses.

The dynamic characteristic refers to the complete measuring equipment including weighting network.

Indication of Instrument
The instrument shall read positive as well as negative deviations as would be obtained, for example, by using a voltage doubler.

Though the meter measures peak-to-peak values, the reading shall indicate the wow in percentage of the figure corresponding to one half the peak-to-peak value.

Because of the finite fall time, it is impossible to avoid variations in the reading with frequency variations of very low frequency. In this case, only the maximum value should be read.



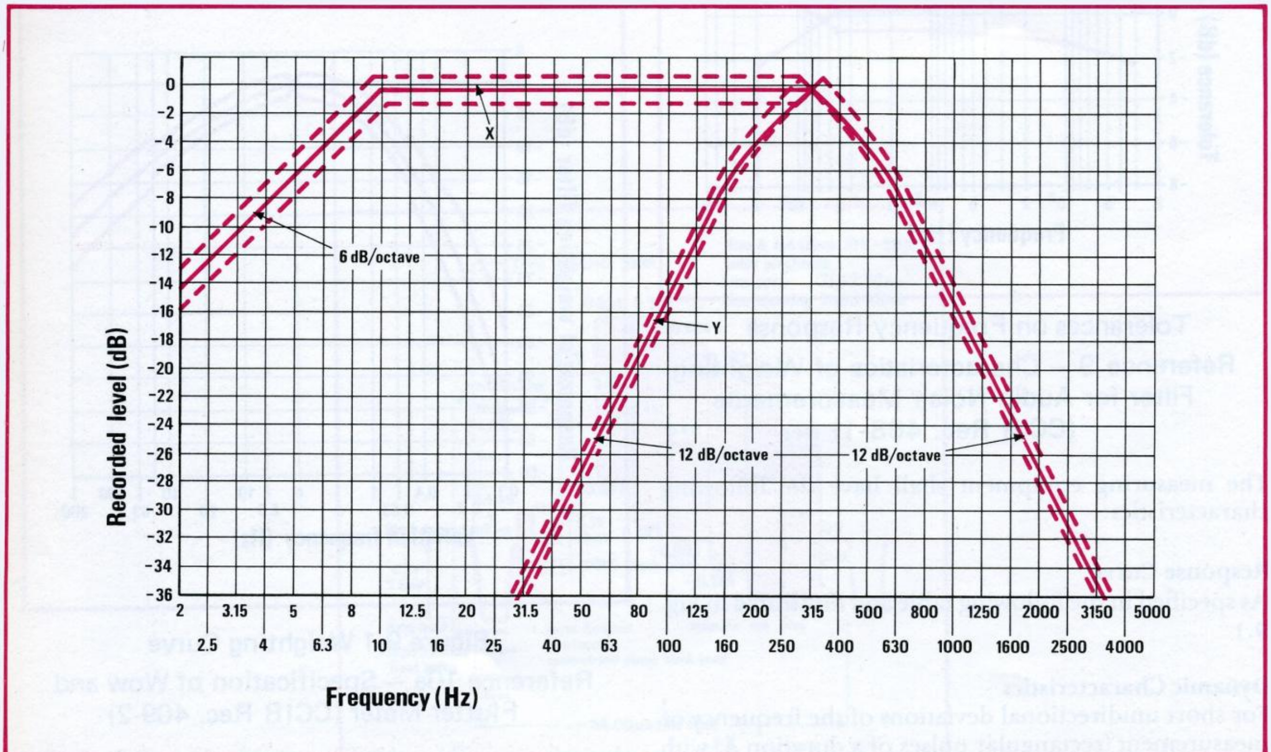
Pulse length A (ms)	10	30	60	100
Indication B (%)	21±3	62±6	90±6	100±4

Figure 9.2 Dynamic Characteristics

Reference 10b – (CCIR Rec. 409-2)

The frequency response of the measuring instrument shall be in accordance with the attenuation curves shown below. Curve X is for unweighted measurements, and curve Y for weighted measurements.

The response to complex waves shall be the



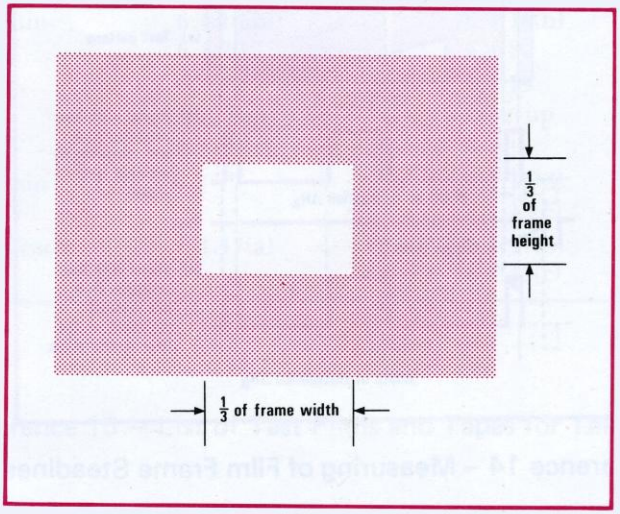
Weighting Curves

Reference 11 – Specification of Rumble Meter to BS4852

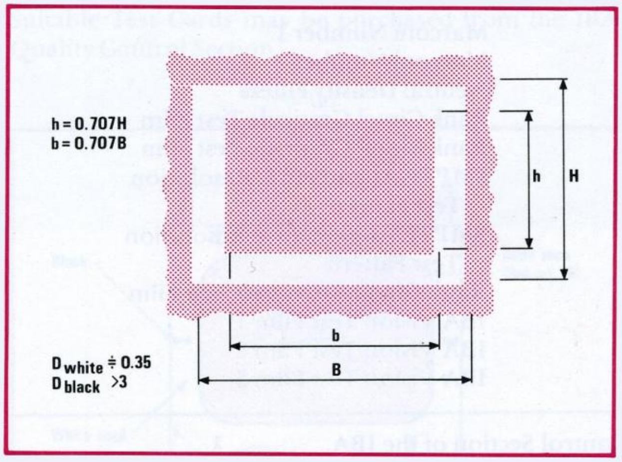
equivalent of a direct current meter and a rectifier, the exponent of whose characteristics is $1{\cdot}2 \pm 0{\cdot}2$.

The indication of the meter shall reach 99% of its steady indication in $5 \pm 0{\cdot}5$ s and shall then overswing its steady deflection by not more than 10% when a voltage which would produce the steady deflection is suddenly applied.

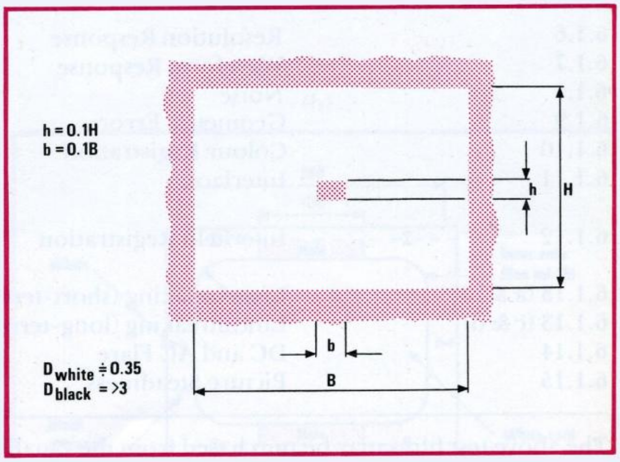
Suitable test films are listed in Section 9, Ref. 15



Reference 12 – Test Pattern for measuring Telecine Long-Term Line Streaking



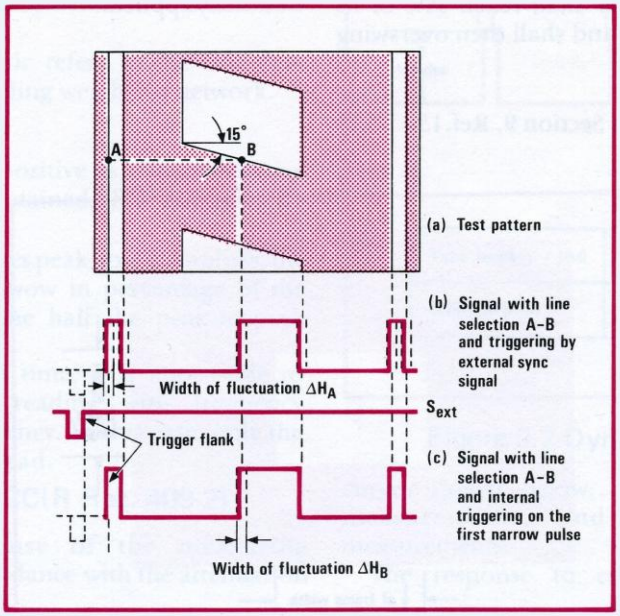
a) Test Pattern for measuring DC flare component



b) Test Pattern for measuring AC flare component

Reference 13 – Test Patterns for measuring Flare in Telecines

Suitable test films are listed in Section 9, Ref. 15



Reference 14 – Measuring of Film Frame Steadiness

Vision Test Films

TEST REFERENCE No.	MEASUREMENT	TEST FILM (16 mm & 35 mm)
6.1.6	Resolution Response	Marconi Number 1
6.1.7	Waveform Response	Marconi Number 1
6.1.8	Noise	Neutral Density Filters
6.1.9	Geometric Errors	Rank Cintel Graticule Test Film
6.1.10	Colour Registration	Rank Cintel Graticule Test Film
6.1.11	Interlace	SMPTE Alignment & Resolution Test Pattern
6.1.12	Interfield Registration	SMPTE Alignment & Resolution Test Pattern
6.1.13 (a & b)	Line Streaking (short-term)	Rank Cintel Afterglow Test Film
6.1.13 (c & d)	Line Streaking (long-term)	IBA Vision Test Film 1
6.1.14	DC and AC Flare	IBA Vision Test Film 2
6.1.15	Picture Steadiness	IBA Vision Test Film 3

The above test films may be purchased from the Quality Control Section of the IBA.

Audio Test Tapes and Films

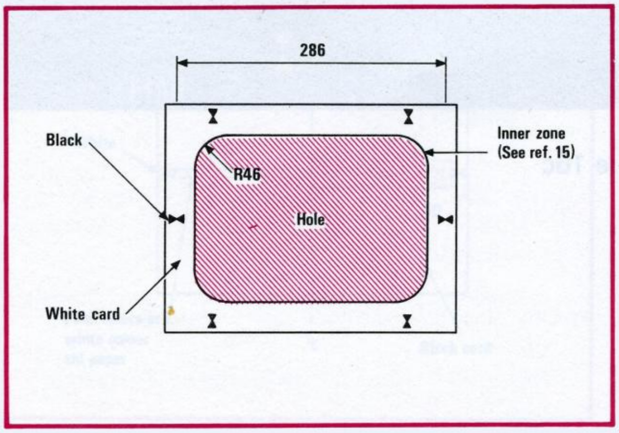
Test tapes and films for COMOPT. (35 mm and 16 mm), COMMAG. (16 mm) and SEPMAG. (35 mm and 16 mm) may be purchased from the Quality Control Section of the IBA. The contents of the tapes and films with the relevant Code of Practice Test Number are given in the following table.

SIGNAL	DURATION	COMOPT. 35 mm & 16 mm	COMMAG. 16 mm	SEPMAG. 35 mm & 16 mm
1 kHz at +8 dBu	2 min	6.1.16(a) 6.1.18(a)	6.1.16(a) 6.1.18(a)	6.1.16(a) 6.1.18(a)
1 kHz at – 10 dBu	2 min	6.1.18(c)	6.1.18(c)	6.1.18(c)
80 Hz at +8 dBu	2 min	6.1.18(b)	6.1.18(b)	6.1.18(b)
80 Hz at – 10 dBu	2 min	6.1.18(d)	6.1.18(d)	6.1.18(d)
3·15 kHz	2 min	6.1.16(b) 6.1.20	6.1.16(b) 6.1.20	6.1.16(b) 6.1.20
1 kHz at 0 dBu	30 s	6.1.19 Line-up	6.1.19 Line-up	6.1.19 Line-up
Buzz Track		6.1.19(c)	—	—
Erased Magnetic	1 min	—	6.1.19(d) 6.1.19(e)	6.1.19(d) 6.1.19(e)
Multi Frequency	8 s each	6.1.17(a) —	6.1.17(b) 6.1.17(c)	6.1.17(b) 6.1.17(c)

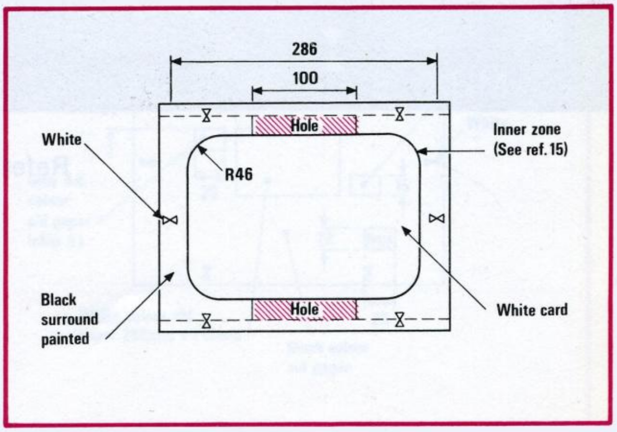
Reference 15 – List of Test Films and Tapes for Telecine

Suitable Test Cards may be purchased from the IBA Quality Control Section

(a)

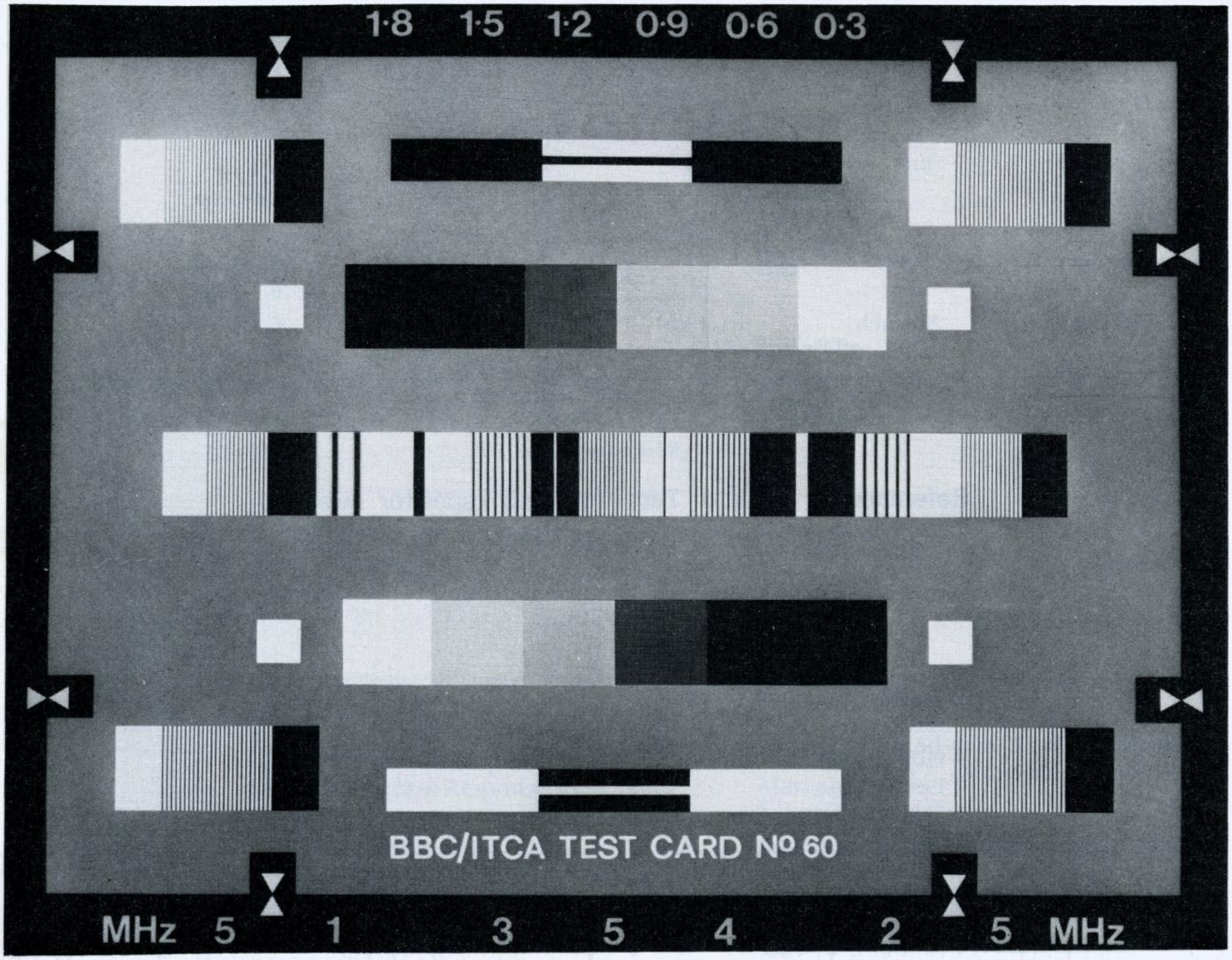


(b)



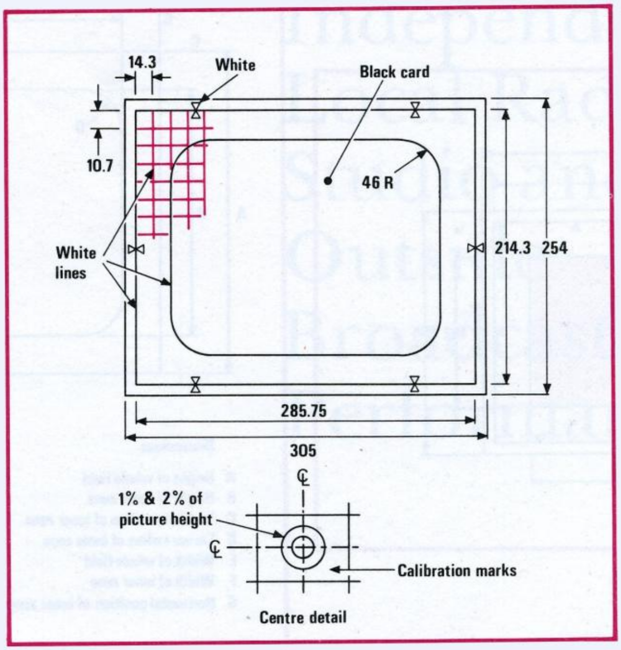
References 16a & 16b – Test Patterns for Camera Tests

Suitable Test Cards may be purchased from the IBA Quality Control Section



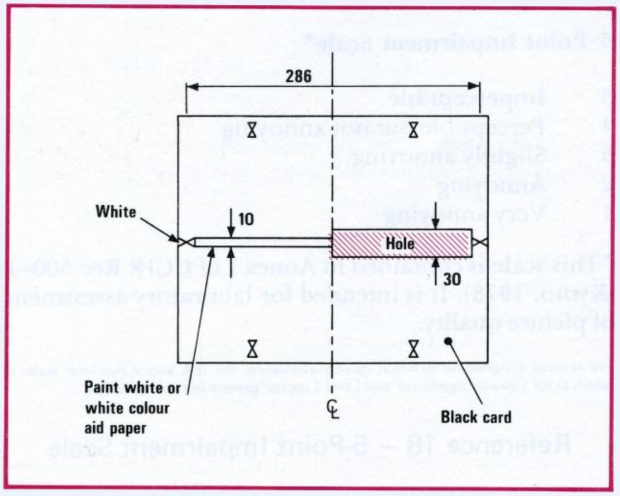
Reference 16c

Suitable Test Cards may be purchased from the IBA Quality Control Section

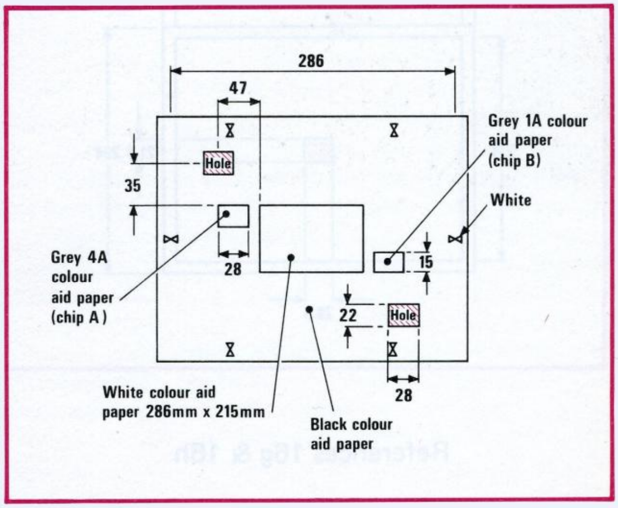


Reference 16d

(e)



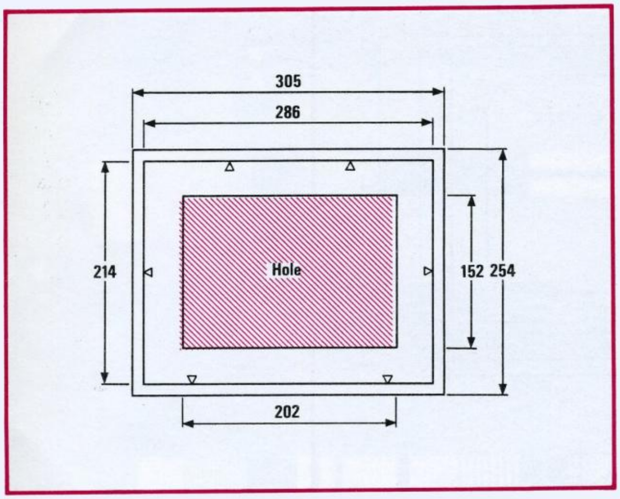
(f)



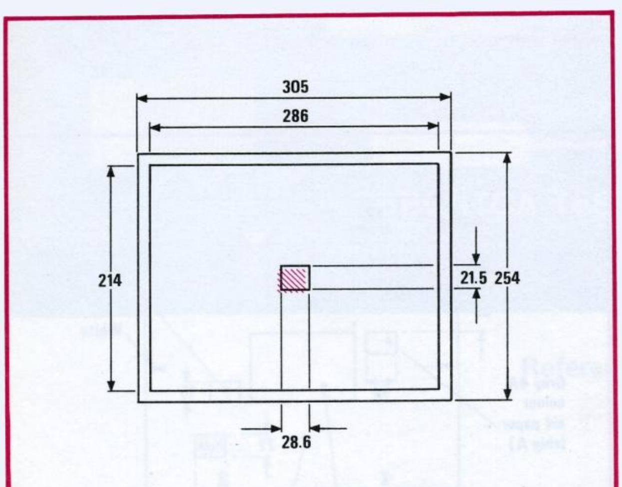
References 16e & 16f

Special Test Cards may be purchased from the IBA Quality Control Section

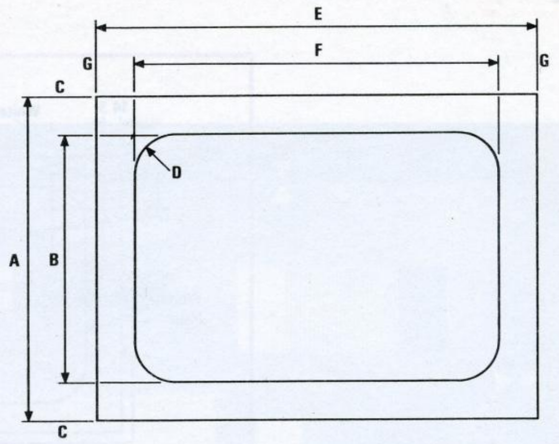
(g)



(h)



References 16g & 16h



	Dimensions	Percentage	
A	Height of whole field	100	Relative to the scanned image height
B	Height of inner zone	80	
C	Vertical position of inner zone	10	
D	Corner radius of inner zone	21	
E	Width of whole field	100	Relative to the scanned image width
F	Width of inner zone	80	
G	Horizontal position of inner zone	10	

The aspect ratio of the scanned image and the inner zone shall be 4:3

Note: The zones defined in this diagram are equivalent to those defined in BS5115

Reference 17 — Picture Zones

5-Point Impairment Scale*

5 Imperceptible
4 Perceptible but not annoying
3 Slightly annoying
2 Annoying
1 Very annoying

*This scale is contained in Annex I of CCIR Rec.500–1 (Kyoto, 1978). It is intended for laboratory assessment of picture quality.

For normal programme technical quality assessment the IBA uses a two-level scale, in which Level 1 means 'significant' and Level 2 means 'present but not significant'.

Reference 18 — 5-Point Impairment Scale

Standards for Independent Local Radio Studio and Outside Broadcast Performance

Section 1 – Definitions and Operational Practices

1.1 General

These standards define the technical requirements applicable to studio centres and Outside Broadcasts. They are not intended for purposes of equipment specification and will be revised periodically, after appropriate consultation, to take account of developments in equipment. However, tolerances will not be tightened beyond the point where satisfactory subjective quality has been achieved. This review specifies parameters which should be met to ensure satisfactory quality for listeners. Where it has been necessary to share the allowable distortions between different parts of the system this has been done, and with due regard to:

i technically achievable tolerances being specified for each part of the system;
ii the need to produce the most economical system.

For clarity, explanatory information concerning the individual tests has been included in each Section. Test parameters have been based upon CCIR recommendations where appropriate. The tolerances quoted should be aimed at on a day-to-day basis.

Since some audio parameters are currently under discussion by the CCIR and by UK broadcasters, it will be necessary from time to time for the Authority to re-issue both the ILR Code of Practice and the Technical Memoranda relating to standard audio measurement procedures. It is possible, therefore, that small inconsistencies between these documents may exist for limited periods. Should doubt arise, advice may be sought from the Authority concerning the details of specifications and measurements.

Note: From time to time IBA staff carry out tests of all installations. Programme Companies are expected, however, to equip themselves with sufficient test equipment to ensure that the standards specified are daily maintained.

1.2 Outside Broadcasts Including News, Sport, and Current Affairs

For Outside Broadcasts of all types, including current affairs, news, sport, music and drama, if equipment of broadcast quality is available it should be used. Where the use of equipment of broadcast quality is found impracticable, equipment of lower technical performance, e.g., telephones and communication links, for broadcasting (monophonic) reports and interviews, may be used. Wherever possible, efforts should be made to improve performance by the use of noise reduction and equalisation techniques.

1.3 Signal Paths

Five signal paths are specified for test purposes, viz:

i Studio Path
ii Worst Path
iii OB Equipment Path
iv News Equipment and Links
v Outside Broadcast Radio Links.

The first four of these paths are dealt with in Section 2 and the fifth in Section 3. For the purpose of measurement, these five paths are defined as follows:

i STUDIO PATH
a Studio microphone inlets, or line level inputs
b Studio mixer
c Main outputs of studio
(All limiters to be by-passed)

ii WORST PATH
a Source studio microphone inlets
b Source studio mixer
c Permanent tie lines
d A second studio mixer
e Permanent tie lines

f Presentation/'on-air' mixer
g Outgoing distribution amplifier(s)
h Station output terminals
(All limiters to be by-passed)

iii OB EQUIPMENT PATH
a Microphone inlets, or line level inputs
b OB mixer
c Output equipment — (measurements taken at the input to the PO line or radio link)
(All limiters to be by-passed)

iv NEWS EQUIPMENT AND LINKS
a Source equipment
b Radio link
c Receiving equipment — (measurements taken at the output of the receiving equipment)

v OUTSIDE BROADCAST RADIO LINKS
a Radio links provided by programme contractors (Ref.A) — (measurements taken at the input to PO line or contractor's studio equipment).

1.4 Tape Recorder and Reproducer Tolerances
Tape recorders and reproducers should employ CCIR equalisation characteristics.

The tolerances relating to magnetic tape recorders (including tape cartridge machines), and quoted in Section 4, refer to a single recording and replay, either on the same machine or on separate machines with similar characteristics. The same tolerances are related to the replay of a standard CCIR test tape, where appropriate.

In principle, the requirements for the technical performance of cartridge machines should be the same as those applicable to reel-to-reel machines. However, the requirements of Section 4 relating to cartridge machines are considerably less stringent than those for reel-to-reel machines because, of necessity, they correspond with the capability of currently available equipment.

Consequently, cartridge machines, unless they conform to the reel-to-reel tolerances shown in this review, should be used only for the origination of news inserts, commercials, presentation, promotion and announcements, unless special circumstances preclude the origination of programme material with equipment of full broadcast performance.

It is recommended that recordings be made at the following standard peak flux levels:

Reel-to-reel machine (monophonic) 320 nWb/m
Reel-to-reel machine (stereophonic) 510 nWb/m
Cartridge machine (stereophonic) 405 nWb/m.

1.5 Test Methods
Unless otherwise stated, measurement methods should comply with IBA recommendations, which are included herein at the end of each Section. These are based on CCIR, CMTT and IEC Recommendations, where appropriate.

1.6 Signal Levels
In all equipment tests, signal levels are measured as voltages, irrespective of impedance, and are quoted in decibels with reference to 0 dBu, where 0 dBu corresponds to 0·775V RMS.

NOTE: *This definition of signal level applies only to equipment test measurements. In the case of lines measurement, where complex impedances are frequently encountered, it is normal practice when setting levels to send from a specified source impedance and to substitute a fixed resistance (usually 600 ohms) at the point of measurement.*

1.7 Studio Monitoring Requirements
1.7.1 Programme Meters
a Peak programme meters, which comply with BS4297, 1968, should be used for the monitoring of programme levels during recording and/or transmission. In no circumstances should PPMs be connected directly across Post Office lines.
b The monitoring of transmission signals should be applied such that the *A, B* and 'M' signals can be monitored simultaneously on PPMs. 'M' is defined as half the sum of *A* and *B* and this should be 0 dBu when the *A* and *B* signals are identical at a level of 0 dBu.

1.7.2 Volume Control Limits
The following table shows the volume levels on an 'M' PPM to which the various categories of programmes should be controlled. These levels are related to standard PPM readings with reference to a steady state reading of '4' corresponding to 0 dBu. The object of specifying these levels is to ensure that subjective volume is, so far as possible, consistent with the programme material while, simultaneously, preventing excessive loudness.

Correct use of this table relies on the operator being able to recognise varying degrees of compression, so that the subjective disturbances caused by changes of excessive loudness between similar material are avoided.

a PEAK PROGRAMME LEVELS AT STATION OUTPUT

PROGRAMME TYPE	NORMAL PEAKS	FULL RANGE
Speech		
Talks, News, Drama, Documentaries, Discussions, Panel Games, Quiz Shows	5	3–6
Music		
Variety, Dance Music	4½	2–6
Brass Bands, Military Bands	4	2–5
Orchestral Concerts	—	1–6
Light Music	5½	2–6
'Pop' records (and any recorded programme) containing a high degree of compression	4	2–4
Record programmes, live 'Pop' shows, neither containing a high degree of compression	5	2–6
Commercials		
Highly compressed	4	2–4
Slightly compressed	5	2–6

b USE OF AUTOMATIC COMPRESSION IN SIGNAL PATH

It is appreciated that normal operational requirements may call for the use of automatic gain control devices. The incorporation of such devices is permissible provided that they do not introduce compression of a ratio greater than 3:2 and that the attack and decay times used do not introduce significant 'pumping'. Where a special effect is occasionally required, more compression may be used; but, whatever degree of compression is employed, subjective loudness should not exceed that resulting from uncompressed material controlled to the limits specified in 1.7.2*a* above, unless the special effect itself requires additional loudness.

When replaying programme material in which compression has been used during recording, no further compression should be introduced.

When automatic volume compression is used in stereophonic installations, the equipment characteristics should be such that no audible image shift occurs under any condition of operation.

1.7.3 Monitoring Loudspeakers

All monitoring of programme material by contractors during transmission and/or recording should be effected by use of a loudspeaker system equivalent in performance to that which is used by the Authority (Ref. 1.B).

1.7.4 Stereophonic Monitoring

The positioning of loudspeaker systems for stereophonic monitoring should be such that the centre points of the HF units are horizontally aligned and 1·8 m apart at listening height. Assuming a line joining these two centre points as being the base of an equilateral triangle, the monitoring point should be the apex.

1.7.5 Monophonic Compatibility

As the stereophonic transmission system utilises the sum of the *A* and *B* signals to provide a monophonic output, it is necessary to ensure that the sum signal can be checked for compatibility. Ideally, the monophonic version of every programme should be checked continuously in a separate cubicle. If this cannot be done, suitable facilities for frequent aural routine checking of the 'M' signal should be provided as to be readily available in the Control/Monitoring Room(s).

1.7.6 Indication of Excessive Level

It is important to ensure that programme signal levels supplied to the *A* and *B* stereo lines, and to the monophonic music line to the MF station, should not exceed +8 dBu. This requirement cannot be met satisfactorily by the use of limiters at the studio output because failure to control the programme level correctly might introduce additional and unwanted volume compression.

As an aid to the sound engineer or programme presenter responsible for the control of signal levels, arrangements should be made for automatic detection of excessive signal level. The automatic detector should be designed such that any level in excess of +8 dBu instantly operates an audible or visible alarm. The detector should be connected at the point where the station output is joined to the PO network.

NOTE: If so desired, the alarm circuit when operated may provide automatic connection of 3 kHz tone to Track 4 of the logging tape (see Section 7.1.2).

REFERENCES TO SECTION 1

1.A: Outside Broadcast Radio Links

For measurement purposes the link should be set up either on a line-of-sight path or on simulated path conditions on a test bench.

1.B: Studio Monitoring Requirements; Monitoring Loudspeakers

The Authority's specification for loudspeakers is in course of preparation.

Section 2 – Signal Paths

PARAMETERS	TOLERANCES			
	STUDIO PATH	WORST PATH	OB EQUIPMENT PATH	NEWS, EQUIPMENT AND LINKS
2.1 *a* Gain Adjustment Error				
(Ref. 2.A)	±0·5 dB	±0·5 dB	±0·5 dB	±1 dB
b Gain stability				
(Ref.2.B)	±0·5 dB	±0·5 dB	±0·5 dB	—
2.2 Amplitude/Frequency Response (wrt 1 kHz)				
(Ref.2.C)				
i 40 Hz to 15 kHz	±1·0 dB	+1·0/−2·0 dB	±1·0 dB	—
ii 125 Hz to 10 kHz	±0·5 dB	+0·5/−1·0 dB	±0·5 dB	—
iii 300 Hz to 5 kHz	—	—	—	±6 dB
2.3 Signal/Noise Ratio				
(Ref.2.D)				
i Weighted, random, peak (70 dB gain)	41 dB	40 dB	41 dB	—
ii Unweighted, random, peak (70 dB gain)	46 dB	45 dB	46 dB	—
iii Weighted, random, peak (50 dB gain)	55 dB	54 dB	55 dB	—
iv Unweighted, random, peak (50 dB gain)	58 dB	57 dB	58 dB	—
v Weighted, random, peak (0 dB gain)	60 dB	56 dB	60 dB	30 dB
vi Unweighted, random, peak (0 dB gain)	63 dB	59 dB	63 dB	33 dB
2.4 Interchannel Crosstalk				
(Ref.2.E)				
i Weighted, random, peak (70 dB gain)	51 dB	50 dB	51 dB	—
ii Weighted, random, peak (50 dB gain)	60 dB	60 dB	60 dB	—
iii Weighted, random, peak (0 dB gain)	60 dB	60 dB	60 dB	—
2.5 Harmonic Distortion				
(Ref.2.F)				
i 1 kHz at all levels up to 0 dBu	0·25%	0·50%	0·25%	—
ii 80 Hz at all levels up to 0 dBu	0·50%	1·00%	0·50%	—
iii 1 kHz at +8 dBu	0·25%	1·00%	0·25%	5·00%
iv 80 Hz at +8 dBu	0·50%	2·00%	0·50%	—
2.6 Level Difference between A & B Channels				
(Ref.2.G)				
i 40 Hz to 15 kHz	1·0 dB	1·5 dB	1·0 dB	—
ii 125 Hz to 10 kHz	0·5 dB	1·0 dB	0·5 dB	—
2.7 Crosstalk between A & B Channels				
(Ref.2.H)				
i 40 Hz	48 dB	46 dB	48 dB	—
ii 40 Hz to 200 Hz	[Oblique segment]			—
iii 300 Hz to 7·5 kHz	53 dB	50 dB	53 dB	—
iv 7·5 kHz to 15 kHz	[Oblique segment]			—
v 15 kHz	48 dB	46 dB	48 dB	—

PARAMETERS	TOLERANCES			
	STUDIO PATH	WORST PATH	OB EQUIPMENT PATH	NEWS, EQUIPMENT AND LINKS
2.8 Phase Difference between A & B Channels (Ref.2.J)				
i 40 Hz	20°	30°	20°	—
ii 40 Hz to 200 Hz	[Oblique segment]			—
iii 200 Hz to 4 kHz	10°	15°	10°	—
iv 4 kHz to 15 kHz	[Oblique Segment]			—
v 15 kHz	20°	30°	20°	—
2.9 Input Balance (Ref.2.K)	−50 dB	−50 dB	−50 dB	−50 dB
2.10 Output Impedance to PO Lines (Ref.2.L)	600 Ω	600 Ω	75 Ω	600 Ω
2.11 Output Balance to PO Lines (Ref.2.M)	−50 dB	−50 dB	−50 dB	−50 dB

REFERENCES TO SECTION 2

2.A: Gain Adjustment Error

The measurements may be made at any overall gain setting. The PPMs, which are used to control the programme output level of each mixer, will be used as the indicating meters. The Gain Adjustment Error is the difference between the indicated level on a PPM and the actual level at the corresponding output. The measurement should be made at an indicated level of 0 dBu on each of the stereo channel outputs.

2.B: Gain Stability

With the input level maintained constant at −50 dBu for microphone level inputs, or 0 dBu for line level inputs, the stability is defined as the greatest change in output level occurring in one hour.

2.C: Amplitude/Frequency Response

This measurement may be made at any gain setting up to the maximum available; the output level should be 0 dBu approximately on each output when the measurement is made.

Tests should be made at the following frequencies: 40 Hz, 60 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 3 kHz, 4 kHz, 6 kHz, 8 kHz, 10 kHz, 12 kHz, 15 kHz.

Additional tests should be made to ensure that the overall response falls off smoothly outside this frequency range. It should be noted that, as this measurement is a test of the variation of gain of the equipment with frequency, correction should be made for any variation of the input level with frequency.

NOTE: For OB equipment used for feeding a PO line or OB Radio Link of restricted bandwidth, the requirements for frequency response in the range 40 Hz to 15 kHz are relaxed to + 1·0/− 2·0 dB.

2.D: Signal/Noise Ratio

The noise measurements may be made under three conditions and in each case both weighted and unweighted measurements should be made. The noise levels should be measured on a standard PPM (to BS4297) with the unweighted bandwidth constrained in accordance with Annex I to CCIR Rec.468-2, Volume X, (Kyoto, 1978), and with the weighted measurements made by use of a CCIR network as defined in Rec.468-1 Volume X, (Geneva, 1974).

For measurements under 2.3(i) to (iv), the input should be 300 ohm terminated; for 2·3 (v) and (vi), a 600 ohm termination should be used. The noise levels should be measured on a standard PPM (to BS4297) with the unweighted bandwidth constrained to 20 kHz by a low-pass filter and with the weighted measurement made by use of a CCIR network (as defined in Rec.468-1, Volume X, Geneva, 1974). This weighting network should follow the curve shown in Figure 1.

For each of the input and gain conditions given below the output level from the signal path should be 0 dBu, i.e., '4' on the measuring PPM. The amplified noise signal also should be made to peak to '4'. The three conditions of measurement are:

i and ii Input level − 70 dBu, output level 0 dBu, with the usual channel, group and main fader (as appropriate) settings, and the balance attenuator adjusted appropriately.

iii and iv Input level − 50 dBu, output level 0 dBu. This condition should be achieved by reducing by 20 dB the gain of the mixer in conditions i and ii by appropriate use of each operational

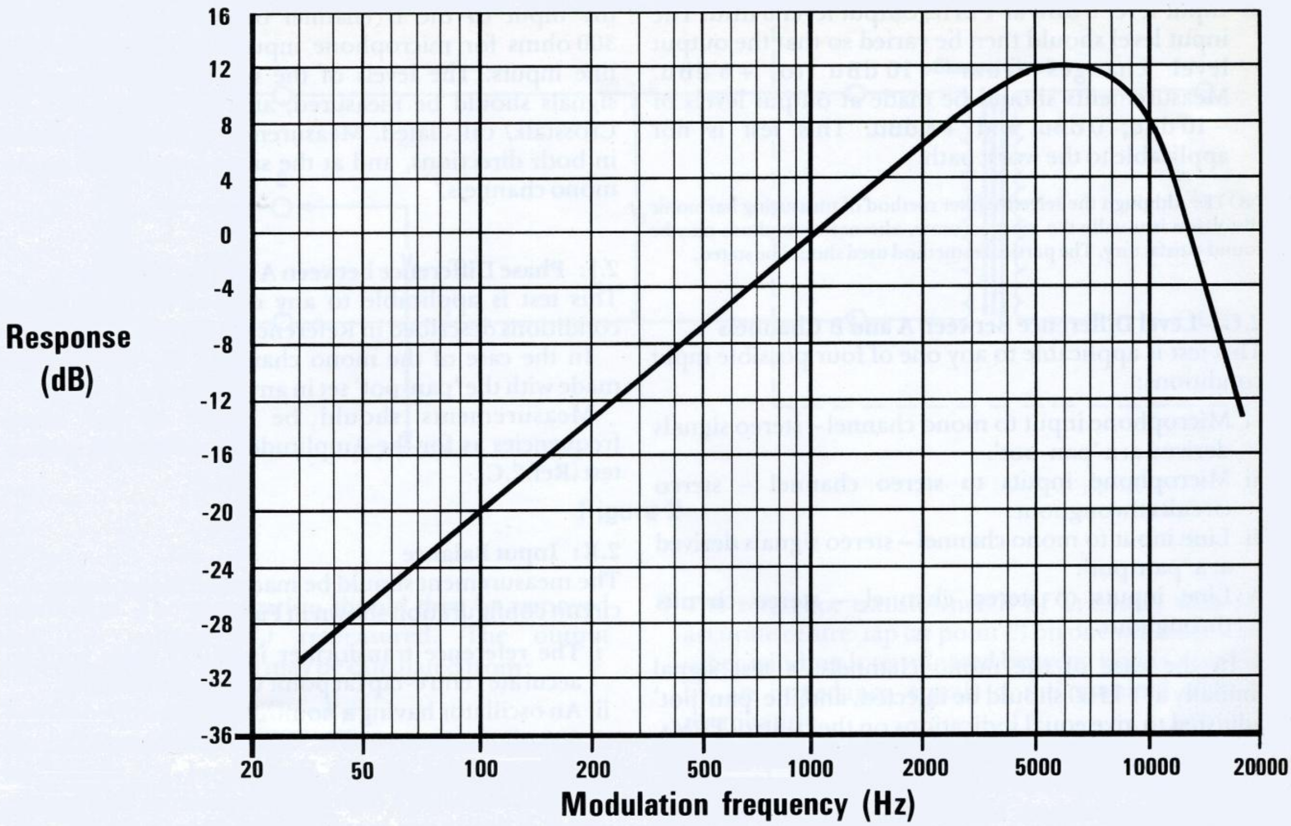


Figure 1

control (balance attenuator, channel, group and main faders).

v and vi Input level 0 dBu, output level 0 dBu, with the balance attenuator, channel, group, and main faders adjusted as appropriate.

2.E: Interchannel Crosstalk

Interchannel crosstalk in this context refers to crosstalk between the circuits under test and any dissociated channel in the installation. Measurements should be made as for weighted noise but with the necessary additional filtering. The test circuit inputs should be terminated in either 300 ohms or 600 ohms, as appropriate, and tones of 50 Hz, 250 Hz, 1 kHz, 6 kHz, 12 kHz and 15 kHz should be fed to any other input point.

The gains of the dissociated channels should be adjusted to produce 0 dBu at each appropriate output of the mixer and measurements should be made with these gain settings at 70 dB, 50 dB and 0 dB.

2.F: Harmonic Distortion

Distortion measurements should be made at three different gain settings, in order to simulate the input levels of dynamic microphones, electrostatic microphones, and line sources:

i *a* Input level – 70 dBu at 1 kHz, output level 0 dBu with normal balance attenuator and channel, group and main fader settings.

b Input level – 50 dBu at 1 kHz, output level 0 dBu, with the balance attenuator setting and group and main fader settings as in (a) above, the gain being reduced by the channel fader only.

c As in (a) except that input level at 1 kHz should be – 50 dBu.

d As in (b) except that input level at 1 kHz should be – 30 dBu.

ii Input level – 50 dBu at 1 kHz, output level 0 dBu. The input level should then be varied so that the output level changes from – 10 dBu to + 8 dBu, at which extremes measurements should be made.

iii Input level 0 dBu at 1 kHz, output level 0 dBu. The input level should then be varied so that the output level changes from −10 dBu to +8 dBu. Measurements should be made at output levels of −10 dBu, 0 dBu and +8 dBu. This test is not applicable to the worst path.

NOTE: Although the selective filter method of measuring harmonic distortion is usually the most accurate, alternative methods may be found satisfactory. The particular method used should be stated.

2.G: Level Difference Between A and B Channels
This test is applicable to any one of four possible input conditions:

i Microphone input to mono channel – stereo signals derived at a 'pan-pot'.
ii Microphone inputs to stereo channel – stereo circuits throughout.
iii Line input to mono channel – stereo signals derived at a 'pan-pot'.
iv Line inputs to stereo channel – stereo circuits throughout.

In the case of the mono channels, a test signal (initially at 1 kHz) should be injected, and the 'pan-pot' adjusted to give equal indications on the control PPMs. The variations with frequency of the output levels of the A and B channels should then be measured and the differences calculated. Measurements should be made at the same frequencies as for the Amplitude/Frequency Response test (Ref.2.C). With stereo channels, test signals from a common source (initially at 1 kHz) should be injected into both channels, the channels being lined-up in the normal way. The variations in output level should be measured and the differences calculated. Measurements should be made at the same frequencies as for the Amplitude/Frequency Response test (Ref.2.C).

2.H: Crosstalk between A and B Channels
In the case of mono channels, a test signal (initially at 1 kHz) should be injected, and the channel routing selector switched, so that the signal is fed to only one output. The level of the wanted signal on this output, and that of the unwanted signal on the other, should be measured; the difference between these two levels is the Crosstalk. Measurements are made at the following frequencies: 40 Hz, 250 Hz, 1 kHz, 6 kHz, 12 kHz, 15 kHz. This test will not be applied to mono microphone channels where the stereo routing is achieved only by means of panning potentiometers. In the case of stereo channels, a test signal (initially at 1 kHz) should be injected at the input of the A channel, the input of the B channel being terminated – in 300 ohms for microphone inputs, and 600 ohms for line inputs. The levels of the wanted and unwanted signals should be measured, and the difference (i.e., Crosstalk) calculated. Measurements should be made in both directions, and at the same frequencies as for mono channels.

2.J: Phase Difference between A and B Channels
This test is applicable to any one of the four input conditions described in Reference G above.

In the case of the mono channels, the test may be made with the 'pan-pot' set in any position.

Measurements should be made at the same frequencies as for the Amplitude/Frequency Response test (Ref.2.C).

2.K: Input Balance
The measurement should be made as follows, using the circuit configuration shown in Figure 2.

i The reference transformer is of 1:1 ratio with an accurate centre-tap (at point C) on one winding.
ii An oscillator having a nominal output impedance of 600 ohms, set to 10 kHz, should be connected across points A and B; the input level V_1, should be measured using a high input impedance instrument. For microphone inputs V_1 should be −60 dBu, and for line level inputs it should be 0 dBu. The output level of the chain under test should be 0 dBu in either case.
iii The oscillator should then be connected between point C and earth. A resistor of 600 ohms should be connected between A and B. The output level of the chain is restored to 0 dBu by increasing the output of the oscillator to a higher level V_2 (in dBu) – measured with the high input impedance instrument. With line level channels, the maximum output of the oscillator may not be sufficient to produce 0 dBu at the chain output. Under these conditions the maximum level from the oscillator should be used, and V_2 is calculated by adding to this level the amount by which the output level of the chain is less than 0 dBu.
iv The input balance $= V_1$ dBu $- V_2$ dBu.

2.L: Output Impedance to PO Lines
A signal, initially at 1 kHz, should be fed into the chain under test. The output should be terminated in 600 ohms; the voltage (V_T) across the termination (R_T) should be measured by use of a high input impedance

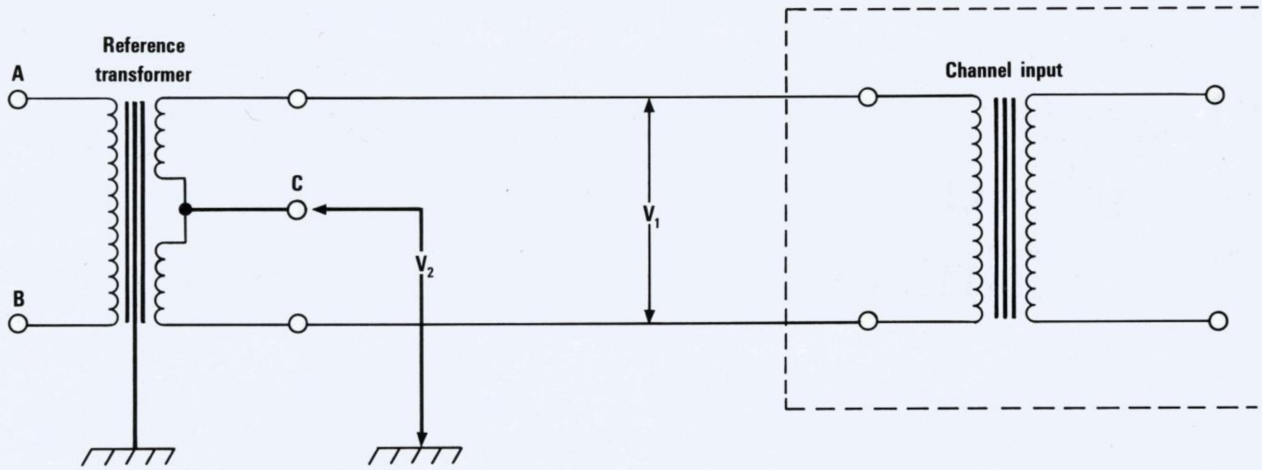


Figure 2

instrument. The termination should then be removed and the voltage (V_o) remeasured. The output impedance (R_0) at 1 kHz may be calculated from:

$$R_o = \frac{R_T(V_o - V_T)}{V_T}$$

The test should be repeated at frequencies of 50 Hz and 10 kHz.

2.M: Output Balance to PO Lines

The measurement should be made as follows, using the circuit configuration shown in Figure 3.

i The reference transformer is of 1:1 ratio with an accurate centre-tap (at point *C*) on one winding. The other winding is terminated between points *A* and *B* by an impedance equal to the nominal output termination.

ii 0 dBu 10 kHz tone should be fed into a line level channel, and the level (V_1) at the output of the chain should be adjusted to 0 dBu.

iii The level (V_2 in dBu) between point *C* and earth should then be measured.

iv The output balance $= V_2$ dBu $- V_1$ dBu.

v The measurements of V_1 and V_2 should be made by use of a high input impedance instrument.

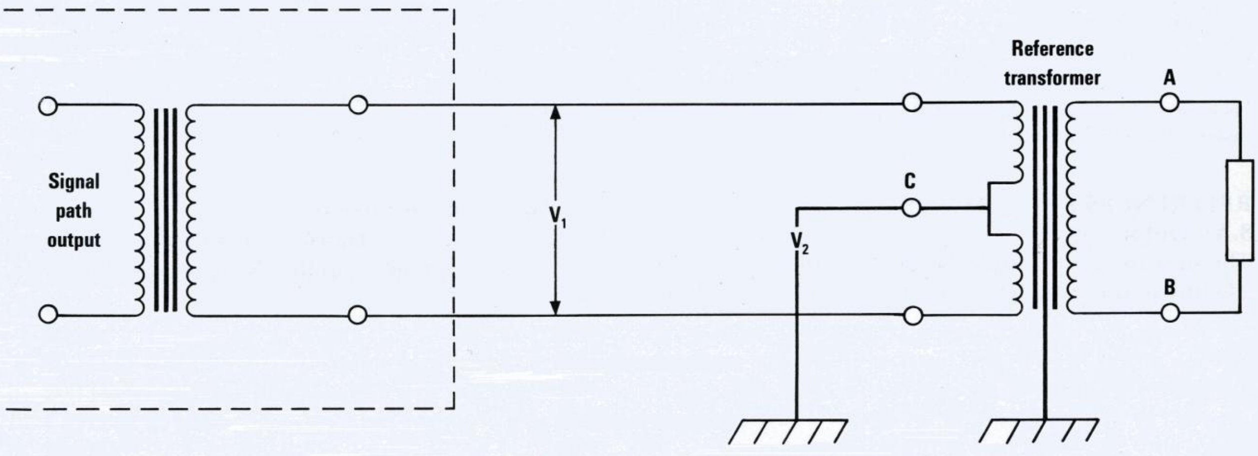


Figure 3

Section 3 – Outside Broadcast Radio Links

PARAMETERS	TOLERANCES
3.1 Monophonic Circuits	
a Output level (Ref.3.A)	0 dBu ± 1·0 dB
b Gain stability (Ref.3.B)	± 1·0 dB
3.2 Amplitude/Frequency Response (wrt 1 kHz) (Ref.3.C)	
a 40 Hz to 10 kHz	+ 2·0 dB/– 3·0 dB
b 125 Hz to 8 kHz	± 1·0 dB
3.3 Signal/Noise Ratio (Ref.3.D)	
Weighted, random, peak	35 dB*
Unweighted, random, peak	40 dB
3.4 Harmonic Distortion (Ref.3.E)	
a 1 kHz at + 8 dBu	2%
b 80 Hz at + 8 dBu	2%

*NOTE: Every endeavour should be made to obtain an improved performance, especially when the link is intended for use with high quality programme material.

REFERENCES TO SECTION 3

3.A: Output Level
The measurement should be made at the input to the PO line or the contractor's studio equipment, and with a 1 kHz tone, at a level of 0 dBu, applied to the transmitter input.

3.B: Gain Stability
With the input level set constant at 0 dBu, the stability is defined as the greatest change in output level occurring in one hour.

3.C: Amplitude/Frequency Response
The measurements should be made at the following frequencies: 40 Hz, 60 Hz, 125 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 6 kHz, 8 kHz, 10 kHz.

The input level to the transmitter should be – 20 dBu. As this measurement is a test of the variation of gain of the equipment with frequency, correction should be made for any variation in input level with frequency.

3.D: Signal/Noise Ratio
The measurements should be made both unweighted and weighted on a standard PPM (to BS4297); the necessary filters are defined in Section 2, Ref.2.D. The input to the transmitter should be terminated in 600 ohms.

3.E: Harmonic Distortion
The input level to the transmitter should be + 8 dBu at both frequencies. See also the 'Note' at end of Ref.2.F, Section 2.

Section 4 – Magnetic Tape Recorders and Reproducers

Parameters	Reel-to-reel	Tolerances Cartridge	 News reel-to-reel
4.1 Insertion Gain Adjustment Error			
(Ref.4.A)	± 1·0 dB	± 1·5 dB	—
4.2 Amplitude/Frequency Response (wrt 1 kHz)			
(Ref.4.B)			
i 40 Hz to 15 kHz	+ 2·0 dB/– 2·5 dB	+ 3·5 dB/– 2·5 dB	—
ii 125 Hz to 10 kHz	± 1·0 dB	—	+ 3·0 dB
iii 250 Hz to 10 kHz	—	± 1·5 dB	—
4.3 Signal/Noise Ratio			
(Ref.4.C)			
i Weighted, random, peak	40 dB	36 dB	35 dB
ii Unweighted, random, peak	45 dB	49 dB	40 dB
4.4 Harmonic Distortion			
(Ref.4.D)			
i 1 kHz at + 8 dBu	2%	4%	3%
ii 80 Hz at + 8 dBu	2%	4%	3%
4.5 Wow and Flutter			
(Ref.4.E)			
Weighted, peak	0·12%	0·15%	0·4%
4.6 Level Difference between A and B Channels			
(Ref.4.F)			
i 40 Hz to 15 kHz	3·0 dB	3·0 dB	—
ii 125 Hz to 10 kHz	1·5 dB	2·0 dB	—
4.7 Crosstalk between A and B Channels			
(Ref.4.G)			
i 40 Hz to 300 Hz	– 6 dB/Octave	– 6 dB/Octave	—
ii 300 Hz to 7·5 kHz	– 40 dB	– 40 dB	—
iii 7·5 kHz to 15 kHz	+ 6 dB/Octave	+ 6 dB/Octave	—
4.8 Phase Difference between A and B Channels			
(Ref.4.H)			
i 40 Hz	60°	—	—
ii 40 Hz to 200 Hz	Oblique segment	—	—
iii 200 Hz to 4 kHz	15°	—	—
iv 4 kHz to 15 kHz	Oblique segment	—	—
v 15 kHz	60°	—	—
vi 50 Hz to 12 kHz	—	90°	—

REFERENCES TO SECTION 4

4.A: Insertion Gain Adjustment Error

The Insertion Gain Adjustment Error is the difference between the input and output levels at 1 kHz. The measurement should be made with an input level of 0 dBu.

4.B: Amplitude/Frequency Response

The measurements should be made at the following frequencies: 40 Hz, 60 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 6 kHz, 8 kHz, 10 kHz, 12 kHz, 15 kHz.

The response should fall smoothly outside this frequency band. The input level to the recorder should be −20 dBu. As this measurement is a test of the variation of gain of the equipment with frequency, correction should be made for any variation in input level with frequency.

4.C: Signal/Noise Ratio

The measurement should be made both weighted and unweighted on a standard PPM (to BS4297); the necessary filter networks are defined in Section 2, Ref.2.D. The input to the recorder should be terminated in 600 ohms. It should be noted that, in addition to the requirements of subsection 4.3, where the signal/weighted noise ratio is between 40 dB and 47 dB the unweighted noise should not exceed the corresponding figure given in Table 1.

4.D: Harmonic Distortion

The input level to the recorder should be + 8 dBu at both frequencies. See also 'Note' at end of Section 2, Ref.2.F.

4.E: Wow and Flutter

Wow and flutter should be measured at a test frequency of 3·15 kHz. The resulting wow and flutter frequencies in the range 200 mHz to 200 Hz should be measured peak weighted using a meter with dynamic characteristics as defined in sub-para (ii) below.

A recorder-reproducer should be measured by recording a 3·15 kHz test frequency, and subsequently reproducing this recording and measuring the total wow and flutter. Only in the case of tape delay machines should wow and flutter be measured while simultaneously recording and reproducing.

The measuring equipment should comply with CCIR Recommendation 409-2, the relevant sections of which are here reproduced:

i Weighting Network
The weighting network should have a response which follows the curve shown in Figure 4.

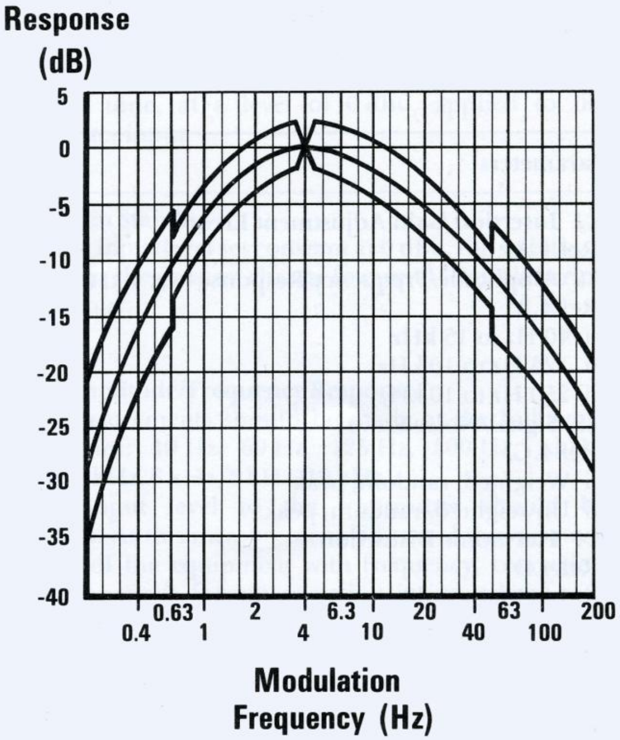


Figure 4

ii Dynamic Characteristics of the Meter. For short unidirectional deviations of the frequency of measurement (rectangular pulses of duration 'A') with a repetition rate of 1 Hz, the meter should indicate the percentage 'B' of the reading obtained

TABLE 1

Signal/weighted noise ratio (dB)	40	41	42	43	44	45	46	47
Minimum signal/unweighted noise ratio (dB)	35	37	39	40	41	42	44	46

with a sinusoidal frequency-modulation of 4 Hz having a peak-to-peak deviation equal to the frequency swing of the pulse, as shown in Table 2. The return time should be such that, when applying pulses of 100 ms duration with a repetition rate of 1 Hz, the meter will indicate 40% ± 10% between pulses.

TABLE 2

Duration of impulse, A, (ms)	10	30	60	100
Indication, B, (%)	21±3	62±6	90±6	100±5

iii Indication
The meter should measure peak-to-peak values, but the reading should indicate the wow as a percentage of the figure corresponding to one half the peak-to-peak value.

4.F: Level Difference between A and B Channels
Measurements should be made at the same frequencies as for the Amplitude/Frequency Response test (Ref.4.B); the input level to the recorder should be −20 dBu. The level difference may be calculated from the measured output levels of the A and B channels at each frequency.

4.G: Crosstalk Between A and B Channels
The test signal, at a level of −20 dBu, should be applied to one input of the recorder, and a 600 ohm termination connected to the input of the other. The Crosstalk may be calculated from the measured outputs of the A and B channels at the following frequencies: 40 Hz, 250 Hz, 1 kHz, 6 kHz, 12 kHz, 15 kHz. The measurements should be repeated with the input conditions transposed.

4.H: Phase Difference between A and B Channels
The input signal should be at a level of −20 dBu. Where the phase difference is not constant, the maximum value will be taken as the measurement.

Section 5 – Signal Sources

5.1 Disc Reproducers
(Ref.5.A)

Parameters	Tolerances
5.1.1 Amplitude/Frequency Response (wrt 1 kHz)	
(Ref.5.B)	
40 Hz to 12·5 kHz	± 2·5 dB
5.1.2 Signal/Noise Ratio	
(Ref.5.C)	
i Weighted, random, peak	50 dB
ii Unweighted, random, peak	55 dB
5.1.3 Rumble	
(Ref.5.D)	
i Weighted	55 dB
ii Unweighted	40 dB
5.1.4 Intermodulation Distortion	
(Ref.5.E)	1·0%
5.1.5 Wow and Flutter	
(Ref.5.F)	
Weighted, peak	0·12%
5.1.6 Level Difference between A & B Channels	
(Ref.5.G)	
40 Hz to 12·5 kHz	1·5 dB
5.1.7 Crosstalk between A & B Channels	
(Ref.5.H)	
40 Hz	12·5 dB
40 Hz to 300 Hz	Oblique segment
300 Hz to 4 kHz	20 dB
4 kHz to 12·5 kHz	Oblique segment
12·5 kHz	12·5 dB
5.1.8 Phase Difference between A & B Channels	
(Ref.5.J)	
40 Hz	40°
40 Hz to 200 Hz	Oblique segment
200 Hz to 4 kHz	20°
4 kHz to 12·5 kHz	Oblique segment
12·5 kHz	36°

5.2 Microphones

Programme contractors should obtain from the IBA, Quality Control Section, approval of any type of microphone intended for programme use.

REFERENCES TO SECTION 5

5.A: Disc Reproducers

Where appropriate, the performance tolerances include a chain comprising a pick-up head and an equalising amplifier.

5.B: Amplitude/Frequency Response

Measurements should be made when replaying the mono side of a test record (to BS1928, 1965) at the following frequencies: 40 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 6·3 kHz, 8 kHz, 10 kHz, 12·5 kHz.

5.C: Signal/Noise Ratio

Measurements should be made, with the turntable running and the pick-up arm on its own rest, both weighted and unweighted on a standard PPM (to BS4297); the necessary filter networks are defined in Section 2, Ref.2.D. The noise levels should be measured relative to the output derived from a peak cutting velocity of 10 cm/s at 1 kHz.

5.D: Rumble

Measurements should be made, both weighted and unweighted, on an indicating instrument as defined in BS4852 (Part 1): 1972.

The necessary filters also are defined in that document. The tests should be made while replaying a test record to DIN 45 544.

5.E: Intermodulation Distortion

Measurements should be made while replaying Side B of a test record to DIN 45 542.

5.F: Wow and Flutter

Measurements should be made while replaying a test record to DIN 45 545 on an instrument having weighting and indicating characteristics as defined in Section 4, Ref.4.E.

5.G: Level Difference between A and B Channels

The A and B channel gains should be adjusted to give equal output levels at 1 kHz and the Level Difference should be calculated for each frequency (as for Amplitude/Frequency Response tests – see Ref.5.B) from the measured outputs of the A and B channels, using the mono side of a test record to BS1928: 1965.

5.H: Crosstalk between A and B Channels

The Crosstalk should be calculated, for each of the following frequencies, from the measured outputs of the A and B channels, using the stereo side of a test record to BS1928: 1965: 40 Hz, 250 Hz, 1 kHz, 6·3 kHz, 12·5 kHz.

5.J: Phase Difference between A and B Channels

Measurements should be made by using the mono side of a test record to BS1928: 1965.

Section 6 – Acoustics

6.1 Reverberation Time (Ref.6.A)
In general, for a studio of given volume, the maximum permissible reverberation time over the frequency range 500 Hz to 2 kHz is as shown in Figure 5. A slightly shorter time (approximately 10% reduction) should be taken as a design criterion. The reverberation time measurements for adjacent octave bands within the range 250 Hz to 4 kHz should not differ by more than 10%. These reverberation times are applicable also to quality check rooms, but a very short reverberation time is costly to obtain and is undesirable in practice. The minimum reverberation time should be no less than one-third of that shown in Figure 5.

6.2 Increase of Reverberation times below 500 Hz
The maximum permissible increase of reverberation times below 500 Hz is dependent on the volume of the studio and the frequency. In Figure 6 the appropriate limits for small studios (not exceeding 120 m^3) are shown as percentage increases. These increases are referred to '100%' which is taken as the longest measured reverberation time in the range 500 Hz–2 kHz. For studios larger than 120 m^3, the low frequency rise should be reduced to the extent that, with studios larger than 300 m^3, no increase at low frequencies occurs.

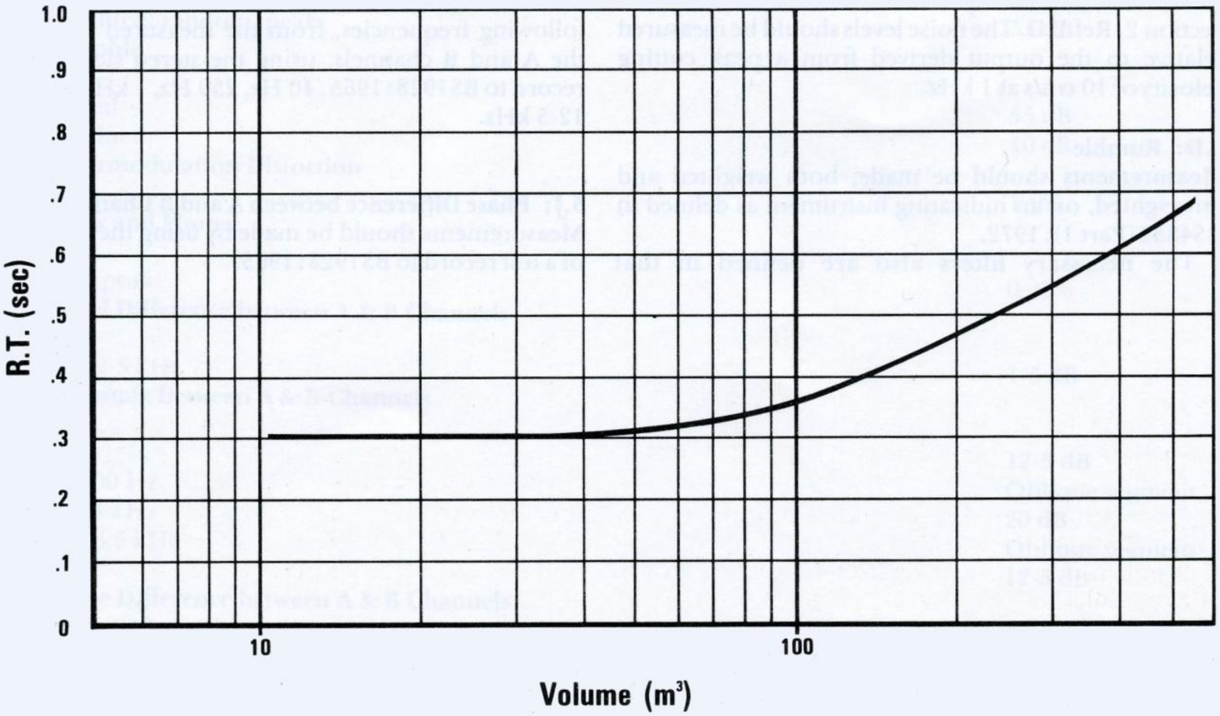


Figure 5
Maximum permissible reverberation times: 500Hz – 2kHz

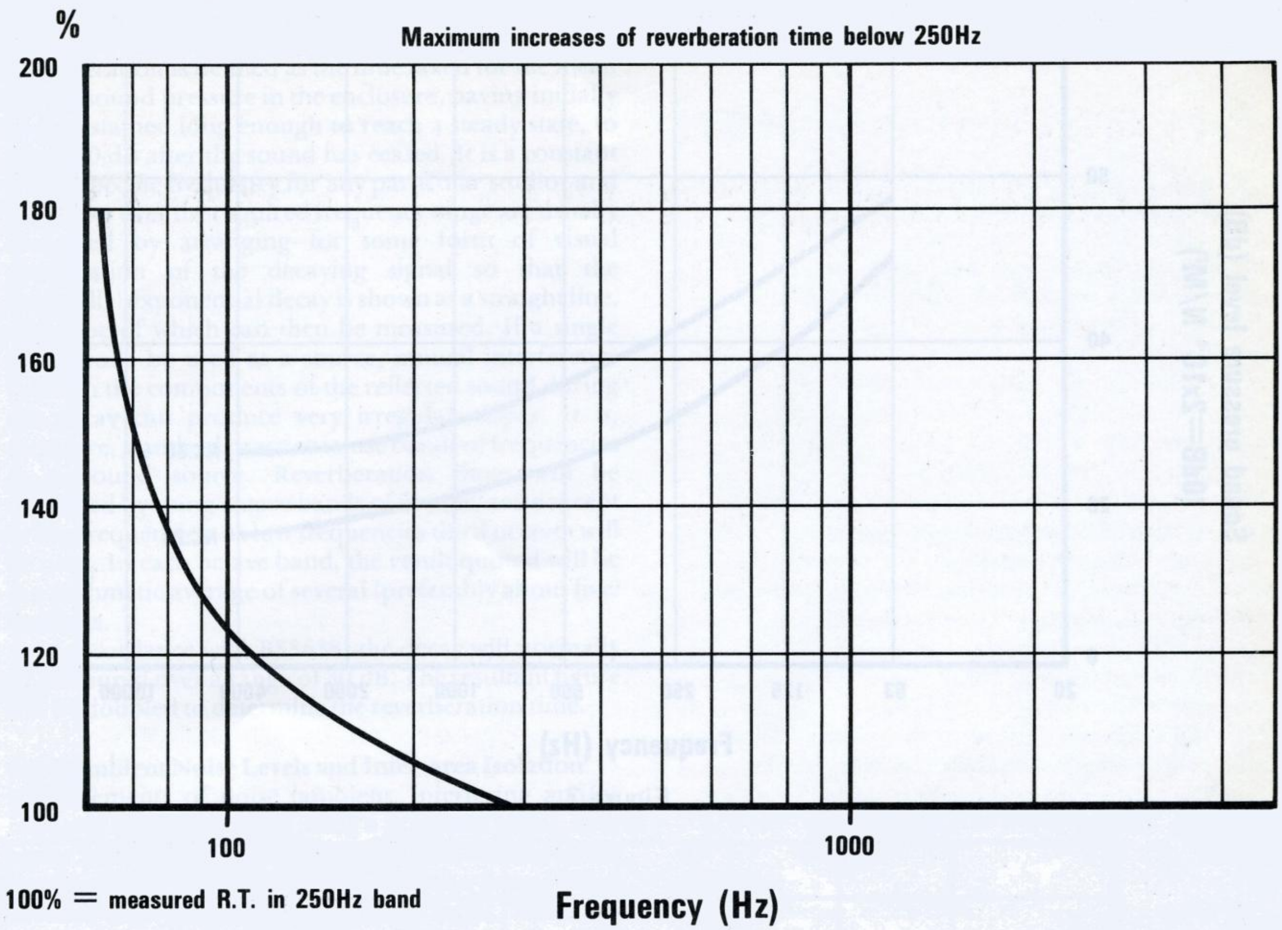


Figure 6

6.3 Reverberation Decay Characteristics
Measured decay slopes should be constant and any significant changes of slope which occur should appear only at levels at least 30 dB below those existing at the start of the decay. There should be freedom from any noticeable colouration and flutter.

6.4 Ambient Noise Levels and Inter-area Isolation (Ref.6.B)
The total noise level (ambient and induced) in working areas should not exceed the following Noise Criteria:

All studios and control rooms with 'on-air' capability, including normal standby areas, NC20.

Quality check rooms and control rooms without 'on-air' capability, NC30.

Announcer booths using the 'close microphone' technique where the maximum microphone distance is 30 cm, NC30.

The appropriate criteria are shown in Figure 7. The figures quoted should be achieved at any time, with normal lighting, ventilation plant and any other ancillary equipment fully operational, and with normal operating environment in adjacent areas.

To test the isolation in appropriate areas the spectra of which will conform to Figure 8, the minimum value of *N* for each of the octave bands 63 Hz to 500 Hz will be taken as follows, unless there is evidence that higher or lower levels are appropriate:

Talks, studios, corridors (including communal sound locks), offices and reception areas . 70 dB.

Control rooms, presentation studios and quality check rooms . . . . 80 dB.

Music studios . . . . 100 dB.

The same criteria should be satisfied under normal impulsive interference conditions.

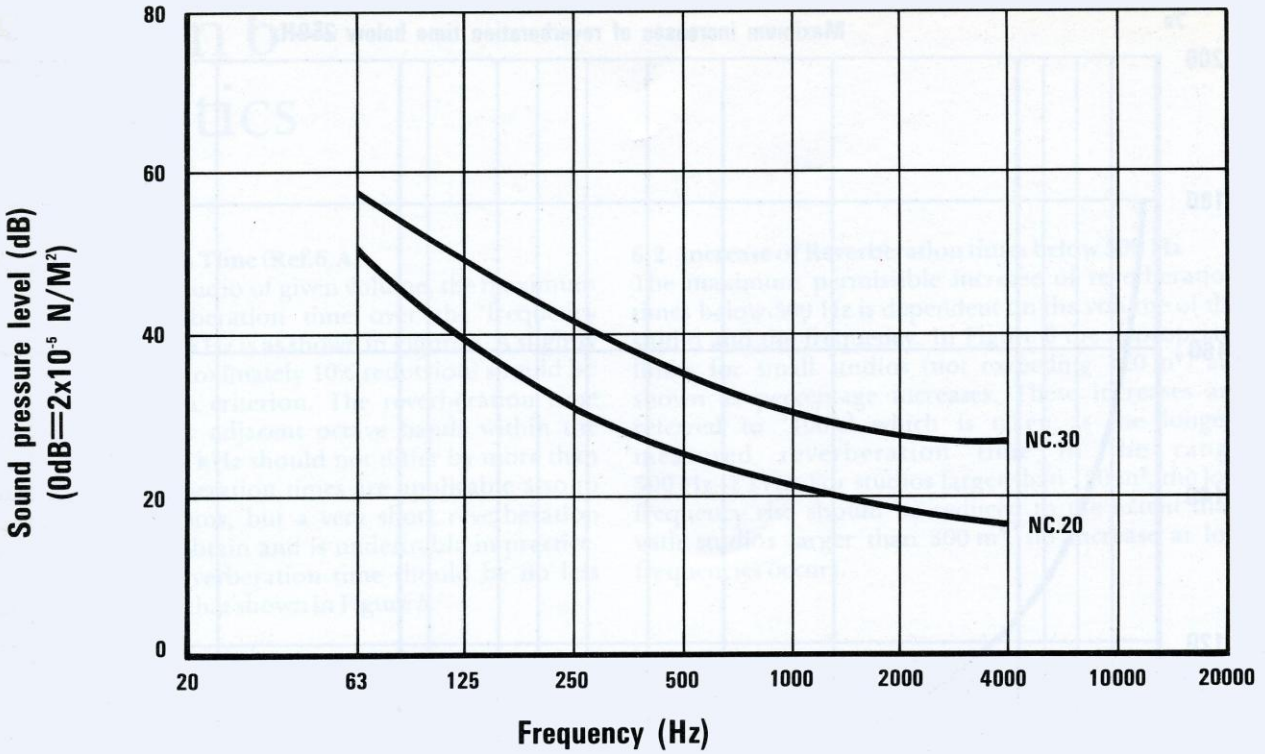


Figure 7

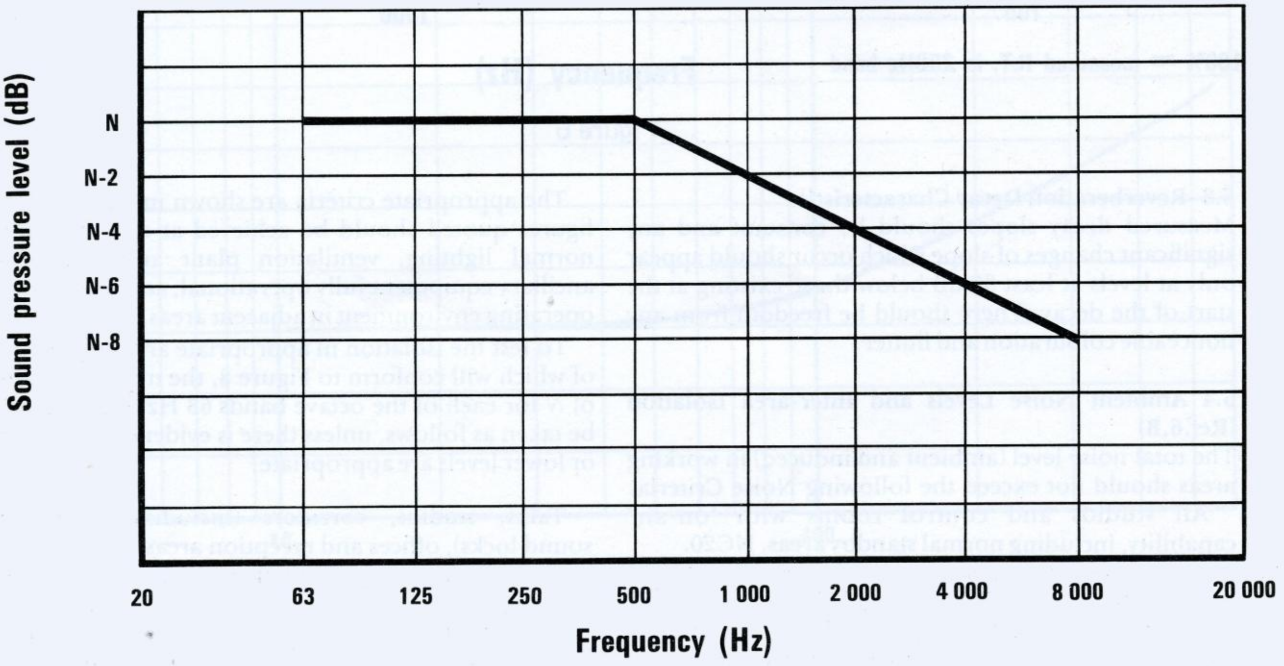


Figure 8

REFERENCES TO SECTION 6

6.A: Reverberation Time

Reverberation is defined as the time taken for the mean square sound pressure in the enclosure, having initially been sustained long enough to reach a steady state, to decay 60 dB after the sound has ceased. It is a constant at any specific frequency for any particular studio; and the values over the required frequency range are usually measured by arranging for some form of visual presentation of the decaying signal so that the (normally) exponential decay is shown as a straight line, the slope of which can then be measured. If a single steady tone be used as a source, mutual interference between the components of the reflected sound during the decay can produce very irregular slopes. It is, therefore, standard practice to use bands of frequencies as a sound source. Reverberation times will be measured by using octave bands of filtered noise except at low frequencies. At low frequencies third octaves will be used. In each octave band, the result quoted will be the arithmetic average of several (preferably about five) readings.

In accordance with BS3638, the decay will normally be measured over a range of 30 dB. The resultant figure will be doubled to determine the reverberation time.

6.B: Ambient Noise Levels and Inter-area Isolation

Measurements of noise (ambient, interfering and/or induced) will be made by using a precision sound level meter and an octave band analyser conforming to the standards specified by IEC 197 (Precision Sound Level Meters) and IEC 225 (Band-Pass Filters). Wherever possible, in each area, at least five measurements will be made in each octave band; the arithmetic average of the sound pressure levels will be quoted for each octave band. For impulsive interference tests, the precision sound level meter will be used with its indicating section operating under the 'Fast' attack and decay characteristics.

Section 7 – Broadcast System Operational Requirements

7.1 System Monitoring Requirements

7.1.1 Receiving Installations

For monitoring purposes, professional receiving equipment, together with associated aerial systems, should be installed to provide a high-fidelity stereophonic output from the VHF transmissions, together with a satisfactory monophonic output from the MF transmissions. Since this receiver may be used for loop testing the system, its performance should be such that the tolerances specified under 'worse path' in Section 2 are not greatly exceeded.

7.1.2 Recording of VHF and MF Transmissions

Arrangements should be made for the entire outputs of the VHF and MF stations to be recorded simultaneously on $\frac{1}{4}$-in magnetic tape, together with timing signals at maximum intervals of 1-min to identify the time of recording. None but standard long-play tape should be used, and the standard of recording should be as follows:

Tape Speed $\frac{15}{16}$ ips (inches per second)
Number of tracks 4
Track Format — 1 VHF Stereo A Signal
– 2 MF Signal
– 3 VHF Stereo B Signal
– 4 Timing Signal.

NOTE: With the tape viewed from the backing side and moving from left to right, the tracks are numbered sequentially from top to bottom.

The tape recorders used for logging purposes should comply with the following performance limits, which relate to a single recording and replay either on the same machine or on separate machines with similar characteristics and normally used for the same purposes:

Frequency response, 300 Hz to 4·5 kHz +2 dB, −4 dB	(wrt 800 Hz)
Signal/Noise Ratio, peak weighted	30 dB
Harmonic Distortion, 1 kHz at +8 dBu	4%
Wow and flutter, peak weighted (in accordance with Section 4, Ref.4.E)	1%

NOTE: The frequency response should be assessed at a reference level of −20 dBu, the peak recording level corresponding to +8 dBu should be 140 nWb/m and the recording characteristic should use a time constant of 120 μs.

7.1.3 Stereo/Mono Status Indication

Provision should be made by the programme contractor for the VHF monitoring receiver pilot tone detector to initiate indication of the stereophonic or monophonic status of the transmitter encoder. This indication should at all times be clearly displayed to the duty operator.

7.2 Transmitter Control Arrangements

7.2.1 Stereo/Mono Switching

In areas where the VHF station has been equipped with stereo/mono remote switching facilities, provision should be made for the installation of the associated tone-code generator and switching unit (to be supplied by the Authority). In such cases, a suitable push-switch should be mounted adjacent to the pilot-tone indicator to initiate the stereo/mono switching function.

7.2.2 Failure of Stereo Channel

Provision should be made for switching either the A and B stereophonic signals or, alternatively, the M signal $(A+B)/2$ to the A and B programme circuits

supplying the VHF transmitter input. This switching will ensure provision of an emergency programme feed on failure of either of the two stereo programme circuits.

7.3 Operational Procedures

The Authority requires that the following operational procedures be implemented at ILR studio centres:

a Normal monitoring to be applied, in accordance with the foregoing Sections, on the received output of the VHF transmission.

b Frequent checks to be made on the technical quality of the compatible monophonic MF transmission.

c The stereo encoder to be remotely switched to the mono mode for monophonic items of reasonable duration and returned to the stereo mode at the end of each such item. For monophonic inserts of short duration, including monophonic commercials, the encoder should be left in the stereo mode.

d The programme contractor to arrange for provision of an alarm indicator, to be located in a prominent position, and to be operated by:

i the common alarm circuit associated with the telemetry system; and

ii the PO power supply unit alarm module (where fitted).

e When the stereo/mono status indicator shows that the transmitter encoder has, by reason of any fault condition, switched automatically to the mono mode, the M signal $(A+B)/2$ should be fed via the A and B circuits to the VHF transmitter. Action should then be taken to determine and diagnose the fault in accordance with standing instructions.

f When a transmitting station fault is detected, the Authority's maintenance service should be advised in accordance with the procedures agreed with the IBA Station Operation and Maintenance Department.

g The Programme Contractor to provide suitable networks for equalizing telephone circuits which are at any time to be used for the live broadcasting of telephone calls. The Programme Contractor to meet the Post Office requirements relating to the broadcasting of any programme material derived from the Post Office telecommunications network.

h The programme contractor should make provision for the origination of a recorded station identification announcement, which should be repeated at maximum intervals of 15 minutes, at all times when programmes are not being originated. The announcement should be carried on both the MF and VHF transmitters and it should identify the programme company, the service area and the carrier frequencies. It should include a reference to the 'Local Radio Service of the Independent Broadcasting Authority'. The texts of all such announcements should be agreed with the IBA, before being used for transmission.

Announcements of this type may be preceded and/or followed by promotional material in accordance with the requirements of programme contractors. Intervals between the announcements (and promotion, if any) should be occupied by 400 Hz tone at an output level of −10 dBu or by a 'ping' tone at intervals of not greater than 10 seconds at the same output level. The levels of night-time announcements and promotional material should be controlled in accordance with the limits shown in Section 1.7.2.

i The programme contractor should provide facilities for the introduction of a time-delay of 7 seconds into the signal path during certain programmes. Such facilities may be provided by means of magnetic recorders with extended tape loops or by means of digital delay units. When using digital delay units the delay time may, until further notice, be reduced to 6·4 seconds.

Use of the delay system is at the discretion of the programme contractor, unless the IBA asks for it to be used during specific programmes.

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Published by the Independent Broadcasting Authority Printed in England by The Whitefriars Press Ltd., London and Tonbridge

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